United States
Department of
Agriculture

Soil
Conservation
Service

In cooperation with
Missouri Agricultural
Experiment Station

Soil Survey of Carroll County, Missouri

How To Use This Soil Survey

General Soil Map

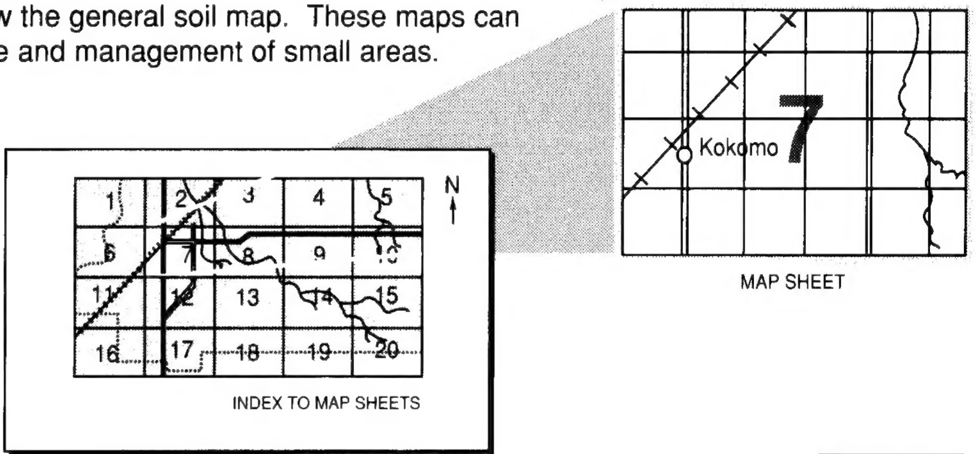
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

Detailed Soil Maps

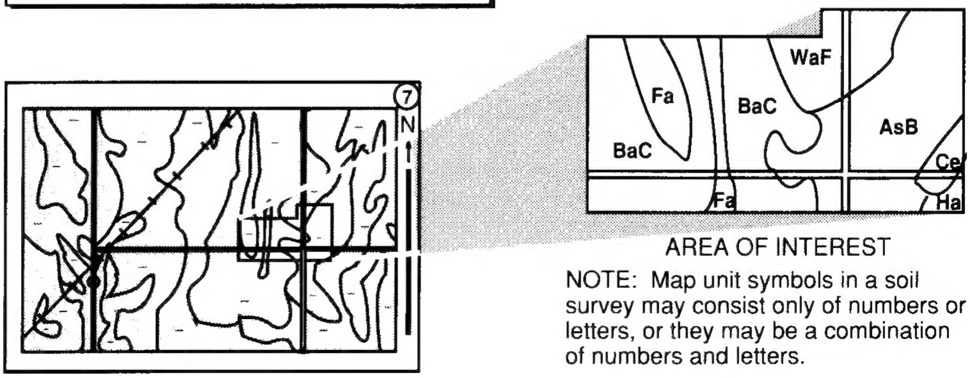
The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.



MAP SHEET

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.



MAP SHEET

AREA OF INTEREST

NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1987. Soil names and descriptions were approved in 1988. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1987. This survey was made cooperatively by the Soil Conservation Service and the Missouri Agricultural Experiment Station. The Missouri Department of Natural Resources provided a soil scientist to assist with the fieldwork. The Carroll County Commission provided funds to the Carroll County Soil and Water Conservation District and the Big Creek Watershed District. Money collected from the State Soil and Parks Sales Tax was used to provide a soil scientist to assist with fieldwork. The survey is part of the technical assistance furnished to the Carroll County Soil and Water Conservation District.

Cover: Typical landscape in the Lagonda-Armster-Grundy association.

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Issued September 1994

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Foreword

This soil survey contains information that can be used in land-planning programs in Carroll County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow over bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

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Soil Survey of Carroll County, Missouri

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United States Department of Agriculture, Soil Conservation Service,
in cooperation with
the Missouri Agricultural Experiment Station

CARROLL COUNTY is in the north-central part of Missouri (fig. 1). It has an area of about 448,992 acres. It is bordered on the south by the Missouri River and on the east by the Grand River. Carrollton, the county seat and the largest town, is in the south-central part of the county. In 1980, Carrollton had a population of 4,700 and the county had a population of 12,066. By 1986, the population of the county had declined to 11,400.

Carroll County is in the Central Feed Grains and Livestock Region of the United States. The southern half of the county is in the Iowa and Missouri Deep Loess Hills land resource area. The northern half is in the Iowa and Missouri Heavy Till Plain land resource area *(7)*.

Farming is the main enterprise in the county. Soybeans, corn, and wheat are the major crops, and beef cattle and hogs are the principal livestock. Forested areas are mostly along drainageways, in the Mandeville Hills, and along the bluffs adjacent to the Missouri River flood plain.

This survey updates the soil survey of Carroll County published in 1912 *(9)*. It provides additional interpretative information and larger maps, which show the soils in greater detail.

This soil survey includes a small area of Saline County, Missouri, that is on the north and west side of the Missouri River. This area is served by the Soil and Water Conservation District of Carroll County. It is shown on the published maps as part of Saline County but is included within the soil survey boundary of Carroll County.

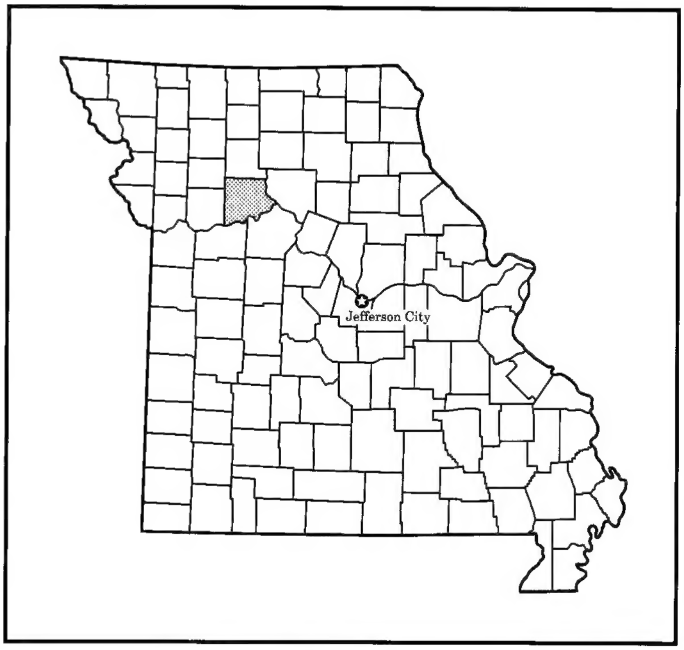

Figure 1.—Location of Carroll County in Missouri.

The current channel of the Grand River is the boundary of the soil survey area, and in most cases it is

the boundary between Chariton and Carroll Counties. Some small areas of Chariton County, however, may be included with the Carroll County soil survey and some small areas of Carroll County may be included with the Chariton County soil survey.

General Nature of the County

This section gives general information concerning the county. It describes climate; history and development; farming; and physiography, relief, and drainage.

Climate

The consistent pattern of climate in Carroll County is one of cold winters and long, hot summers. Heavy rains occur mainly in spring and early in summer, when moist air from the Gulf of Mexico interacts with drier, continental air. The annual rainfall is normally adequate for corn, soybeans, and all grain crops.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Marshall, Missouri, in the period 1951 to 1986. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 32 degrees F and the average daily minimum temperature is 22 degrees. The lowest temperature on record, which occurred at Marshall on January 17, 1977, is -16 degrees. In summer, the average temperature is 77 degrees and the average daily maximum temperature is 89 degrees. The highest recorded temperature, which occurred on July 14, 1954, is 112 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 36 inches. Of this, more than 23 inches, or about 65 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 18 inches. The heaviest 1-day rainfall during the period of record was 5.87 inches at Marshall on April 21, 1973. Thunderstorms occur on about 53 days each year.

The average seasonal snowfall is about 14 inches. The greatest snow depth at any one time during the period of record was 8 inches. On the average, 8 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 65 percent of the time possible in summer and 50 percent in winter. The prevailing wind is from the south-southeast. Average windspeed is highest, 12 miles per hour, in spring.

Tornadoes and severe thunderstorms occur occasionally but are local and of short duration. Damage varies and is spotty. Hailstorms occur sometimes during the warmer part of the year but in an irregular pattern and in only small areas.

History and Development

When French traders first visited Carroll County, the Sac and Fox Indians occupied the territory just west of the Grand River and used this area as their hunting grounds. In 1819, the first permanent white settlement was made by John Standley and William Turner near the present site of Carrollton *(3)*. Settlers were attracted by the fertile soils and the plentiful timber.

Carroll County was organized on January 2, 1833. It was named after Charles Carroll of Maryland, the last surviving person who had signed of the Declaration of Independence. Carrollton was designated as the county seat on December 2, 1833 *(8)*. Other important but smaller communities are Norborne, in the southwestern part of the county, and Hale, in the northeastern part.

The main east-west highways crossing Carroll County are Missouri Highway 10 and U.S. Highway 24. Most north-south travel is on U.S. Highway 65. The county is served by three railroads.

Farming

Early settlements in Carroll County were located on the flood plains and in the foothills along the Missouri River, in areas convenient to food, water, and fuel. The settlers raised a few cows, hogs, and chickens and planted corn and wheat.

In 1900, Carroll County had 3,692 farms. The number of farms has steadily declined. In 1982, the county had 1,099 farms with an average size of 377 acres *(3)*.

Much of the county is tillable and is used for row cropping. Livestock generally are raised in the steeper areas. In 1982, livestock made up about 44 percent of all farm products sold in Carroll County and crops made up about 56 percent. In 1984, the county ranked 11th in corn production, 11th in wheat production, and 13th in soybean production among Missouri's 114 counties *(3)*.

Physiography, Relief, and Drainage

The uplands of Carroll County primarily consist of an old glacial till plain that has been highly dissected by geologic erosion. Thick deposits of loess cover the areas closest to the Missouri River flood plain. The deposits gradually become thinner to the north, where the glacial till occupies the lower side slopes. Residual material is exposed on the steeper landscapes in the county. A large area of this material extends from Livingston County into the northwest corner of Carroll County to just south of Mandeville. The area is known as the Mandeville Hills.

Carroll County has more Missouri River bottom land than any other county in Missouri *(8)*. The Missouri River has a nearly level flood plain that is about 9 miles wide at the widest point. Elevation varies from about 630 feet in the southeast corner of the county to about 990 feet in the northwestern part of the county.

The main streams in the county are the Missouri River, the Grand River, and their larger tributaries. Wakenda Creek and its tributaries drain most of the western part of the county, the southern part of the uplands, and the northern part of the bottom lands. The creek flows eastward to the Missouri River. Big Creek, Hurricane Creek, and their tributaries drain most of the northeastern part of the county into the Grand River.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable

from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by two or three kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are named and mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

General Soil Map Units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The descriptions, names, and delineations of the soils identified on the general soil map of this county do not fully agree with those of the soils identified on the maps of adjacent counties published at a different date. Differences are the result of additional soil data, variations in the intensity of mapping, and correlation decisions that reflect local conditions. In some areas combining small acreages of similar soils that respond to use and management in much the same way is more practical than mapping these soils separately.

Soil Descriptions

1. Gosport-Greenton-Sharpsburg Association

Moderately deep and deep, gently sloping to steep, moderately well drained and somewhat poorly drained soils that formed in shale residuum and in loess; on uplands

This association is on narrow ridgetops and highly dissected side slopes near the major drainageways. It makes up about 12 percent of the survey area. It is about 39 percent Gosport soils, 37 percent Greenton and similar soils, 17 percent Sharpsburg and similar soils, and 7 percent minor soils.

Gosport soils are moderately deep and moderately well drained. They are on side slopes near the drainageways. Typically, the surface layer is very dark grayish brown silty clay loam. The upper part of the subsoil is brown silty clay loam. The lower part is brown and grayish brown, mottled silty clay loam and silty clay. The substratum is olive gray, mottled silty clay. It is underlain by soft, weathered shale bedrock.

Greenton soils are deep and somewhat poorly drained. They generally are on foot slopes below the Gosport soils or on side slopes between the Gosport and Sharpsburg soils. Typically, the surface layer is very dark grayish brown silty clay loam. The upper part of the subsoil is brown, mottled silty clay loam. The next part is dark yellowish brown and light olive brown, mottled silty clay. The lower part is yellowish brown, mottled silty clay. The substratum is multicolored silty clay.

Sharpsburg soils are deep and moderately well drained. They generally are on ridgetops and side slopes above the Gosport soils. Typically, the surface layer is very dark grayish brown silt loam. The subsurface layer is dark brown silty clay loam. The upper part of the subsoil is brown silty clay loam. The lower part is brown and dark yellowish brown, mottled silty clay loam.

Of minor extent in this association are Colo and Nodaway soils. Colo soils are poorly drained, and Nodaway soils are moderately well drained. They are on flood plains along small streams.

The cleared acreage of this association is used for pasture, hay, or cultivated crops. Soybeans, wheat, and grain sorghum are the major crops. Grasses and legumes are grown for pasture and hay. Erosion and the slope are the major management problems. Overgrazing or grazing during wet periods can cause rapid erosion.

The uncleared acreage is mostly in the rough, strongly sloping to steep areas of the Gosport soils. These areas generally support native hardwoods. Oak and hickory are the dominant species. The slope restricts the use of logging equipment, and erosion is a hazard along logging roads and skid trails.

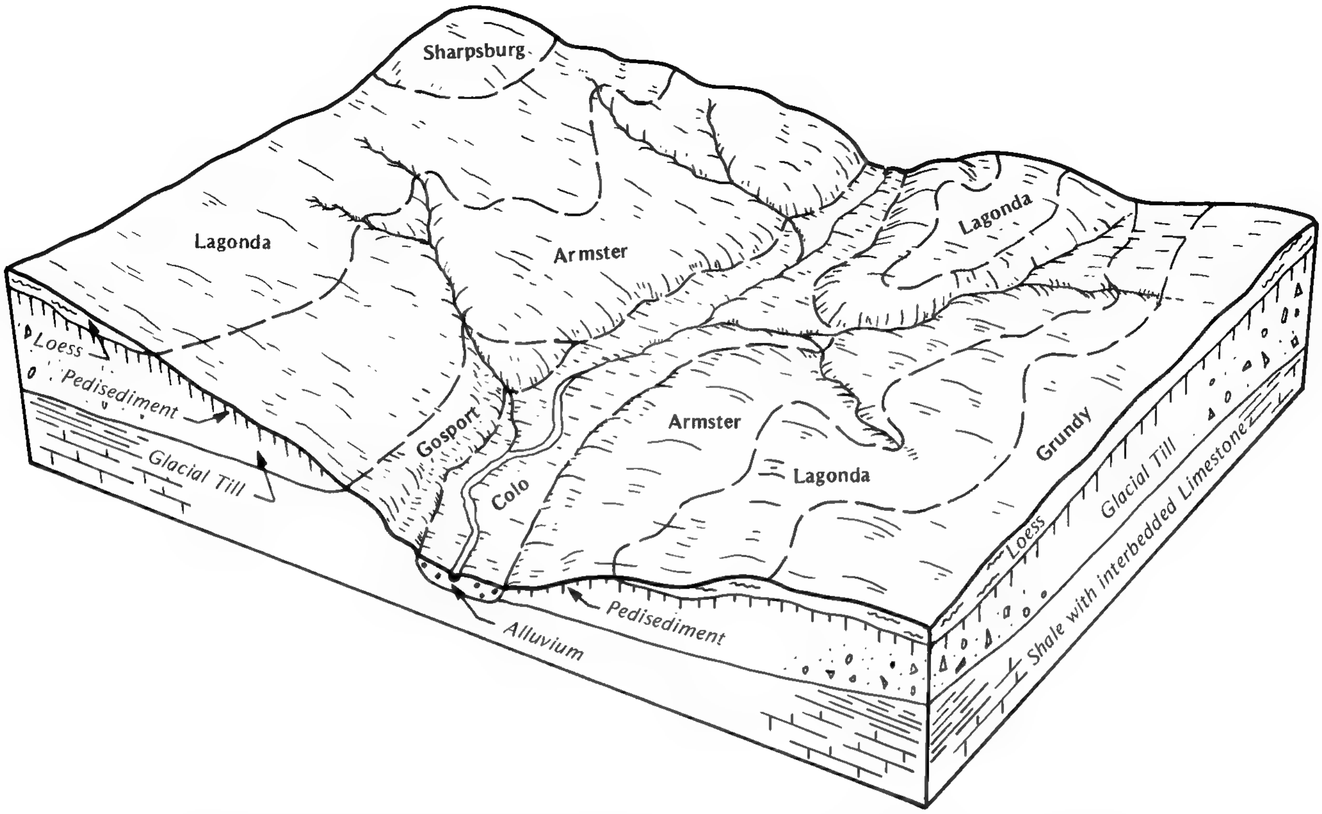

Figure 2.—Typical pattern of soils and parent material in the Lagonda-Armster-Grundy association.

This association is suited to building site development and sanitary facilities. Moderately slow or very slow permeability, the slope, a high shrink-swell potential, the wetness, and depth to bedrock are the major limitations.

2. Lagonda-Armster-Grundy Association

Deep, gently sloping to strongly sloping, somewhat poorly drained and moderately well drained soils that formed in loess, pedisediment, and glacial till; on uplands

This association is on ridgetops and moderately dissected side slopes adjacent to small drainageways. It makes up about 40 percent of the survey area. It is about 56 percent Lagonda and similar soils, 20 percent Armster soils, 13 percent Grundy soils, and 11 percent minor soils (fig. 2).

Lagonda soils are somewhat poorly drained. They are on ridgetops and in slightly concave areas on side slopes. Typically, the surface layer is black silt loam and the subsurface layer is black silty clay loam. The upper part of the subsoil is dark grayish brown silty clay loam. The next part is dark grayish brown, mottled silty clay loam. The lower part is grayish brown, mottled silty clay and clay.

Armster soils are moderately well drained. They are on narrow, sloping ridgetops and convex side slopes. Typically, the surface layer is very dark grayish brown loam. In sequence downward the subsoil is brown and dark yellowish brown, mottled clay loam; dark yellowish brown, mottled clay; mottled strong brown, light brownish gray, and yellowish brown clay; and yellowish brown and light brownish gray, mottled clay loam.

Grundy soils are somewhat poorly drained. They are on the broader ridgetops. Typically, the surface layer is very dark grayish brown silt loam and the subsurface layer is very dark grayish brown silty clay loam. The upper part of the subsoil is dark grayish brown and grayish brown, mottled silty clay. The lower part is grayish brown, mottled silty clay loam.

Of minor extent in this association are Gosport, Colo, and Sharpsburg soils. Gosport soils are moderately well drained and are moderately deep. They are on the lower side slopes. Colo soils are poorly drained and are on flood plains along small streams. Sharpsburg soils are moderately well drained and have a thick, dark surface layer. They are on the narrower ridgetops in

landscape positions slightly higher than those of the major soils.

Raising livestock and growing grain crops are the main agricultural enterprises in areas of this association. Soybeans, corn, and small grain are grown in the less sloping areas. Most of the steeper areas are used for pasture and hay. Measures that help to control erosion and maintain tilth and fertility are the major management needs.

This association is suited to building site development and sanitary facilities. A high shrink-swell potential, the slope, moderately slow or slow permeability, and the wetness are the major limitations.

3. Colo-Nodaway Association

Deep, nearly level, poorly drained and moderately well drained soils that formed in alluvium; on flood plains

This association is on flood plains along the intermediate and small tributaries of the Missouri River. It makes up about 12 percent of the survey area. It is about 42 percent Colo and similar soils, 42 percent Nodaway soils, and 16 percent minor soils (fig. 3).

Colo soils are poorly drained. They are on flood plains between the Nodaway soils and the uplands. Typically, the surface layer is very dark grayish brown silty clay loam. The subsurface layer is very dark grayish brown, very dark gray, and black silty clay loam. The subsoil is very dark gray and black, mottled silty clay loam.

Nodaway soils are moderately well drained. They are near the stream channels. Typically, the surface layer is very dark grayish brown silt loam. The substratum is stratified, multicolored silt loam.

Of minor extent in this association are Bremer and Wabash soils. Bremer soils have more clay than the major soils and are on low stream terraces. Wabash soils are very poorly drained and are farther from the stream channels than the major soils.

Growing grain crops is the main agricultural

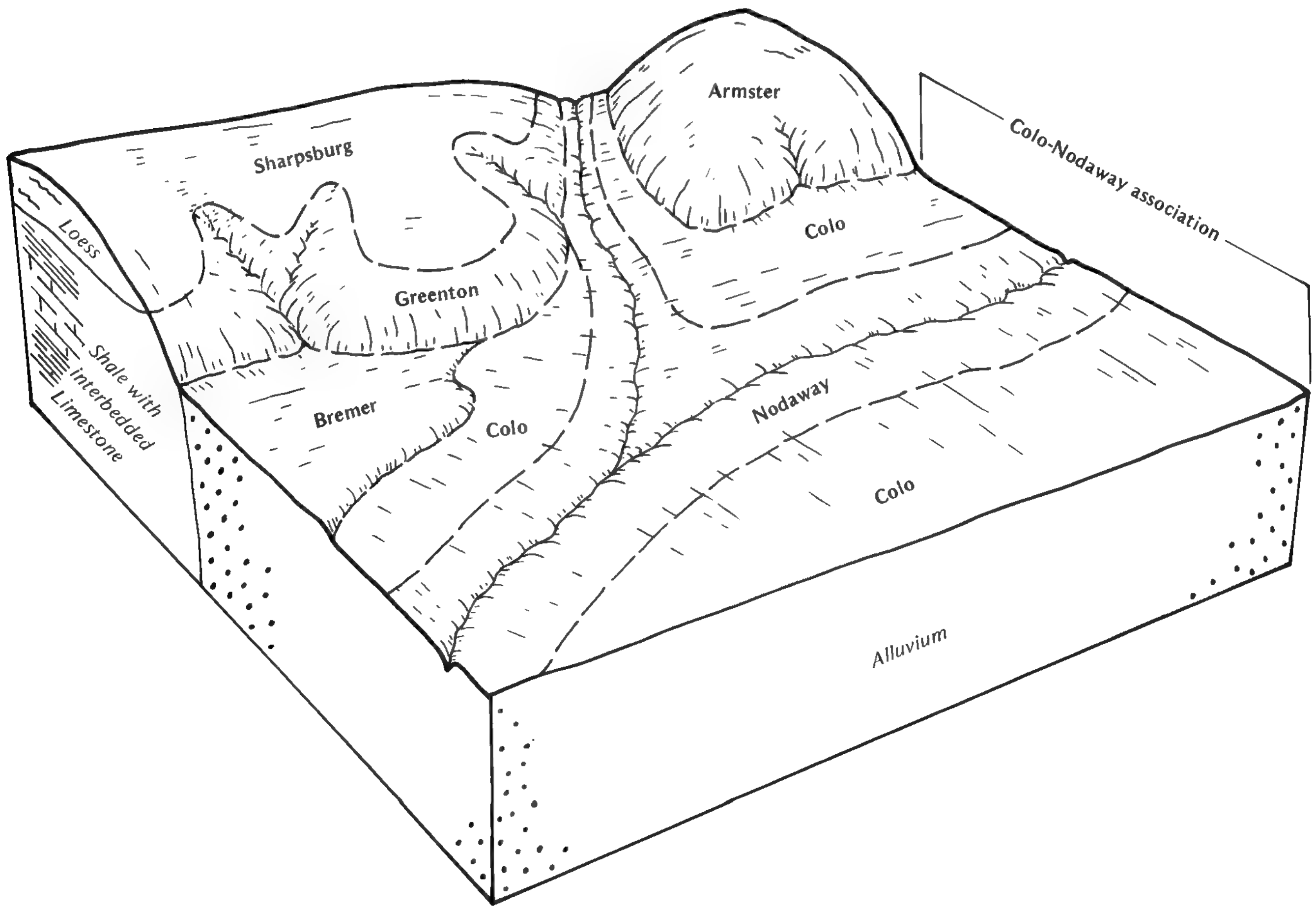

Figure 3.—Typical pattern of soils and parent material in the Colo-Nodaway association.

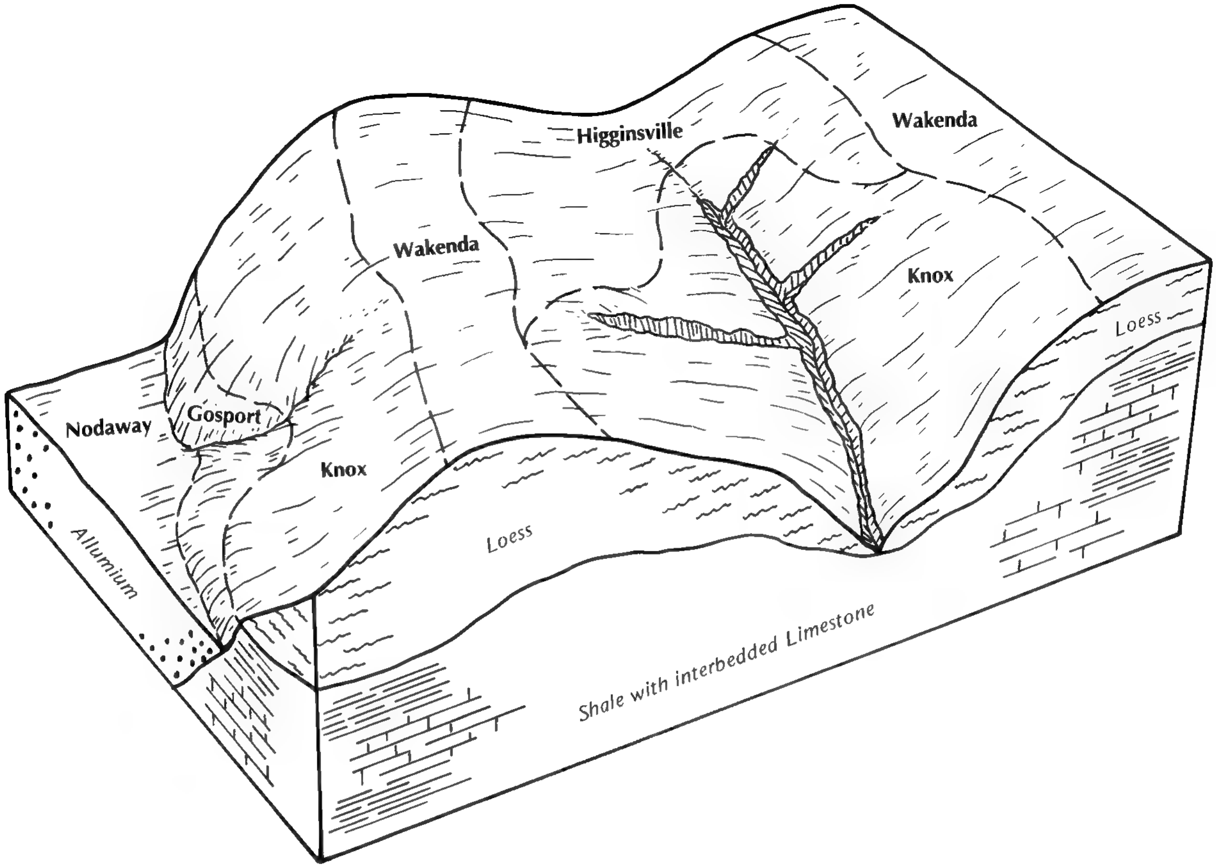

Figure 4.—Typical pattern of soils and parent material in the Knox-Higginsville-Wakenda association.

enterprise in areas of this association. Soybeans, corn, and small grain are the major crops. The flooding and the wetness are the major management concerns.

This association generally is unsuitable for building site development and sanitary facilities because of the wetness and the flooding.

4. Knox-Higginsville-Wakenda Association

Deep, gently sloping to steep, well drained and somewhat poorly drained soils that formed in a thick layer of loess; on uplands

This association is on narrow and moderately wide ridgetops and side slopes. It makes up about 10 percent of the survey area. It is about 31 percent Knox soils, 30 percent Higginsville and similar soils, 29 percent Wakenda and similar soils, and 10 percent minor soils (fig. 4).

Knox soils are well drained. They are on narrow ridgetops and convex side slopes. Typically, the surface layer is very dark grayish brown silt loam. The subsoil is brown and dark yellowish brown silty clay loam. The lower part of the subsoil is mottled. The substratum is brown, mottled silt loam.

Higginsville soils are somewhat poorly drained. They are in concave areas on side slopes. Typically, the surface layer is very dark grayish brown silt loam. The subsoil is dark grayish brown and grayish brown, mottled silty clay loam. The substratum is grayish brown, mottled silty clay loam.

Wakenda soils are well drained. They are on ridgetops, convex side slopes, and high stream terraces. Typically, the surface layer is very dark grayish brown silt loam. The upper part of the subsoil is very dark grayish brown and brown silty clay loam. The lower part is brown, mottled silty clay loam.

Of minor extent in this association are the poorly drained Colo soils and the moderately well drained Gosport and Nodaway soils. Colo and Nodaway soils are on bottom land. Gosport soils are in low areas on upland slopes, in landscape positions below those of the major soils.

Growing grain crops and raising livestock are the major agricultural enterprises in areas of this

association. Soybeans, wheat, and corn are grown in the less sloping areas. Cool-season grasses and legumes are grown for pasture and hay. Measures that help to control erosion are the major management needs if row crops are grown. Overgrazing pastures during wet periods can cause rapid erosion in steep areas.

The uncleared acreage is mostly in the moderately steep and steep areas of the Knox soils. Oak and hickory are the dominant trees. The slope restricts the use of logging equipment, and erosion is a hazard along logging roads and skid trails.

This association is suited to building site development and sanitary facilities. The slope, a moderate shrink-swell potential, and the potential for frost action are the major limitations.

5. Bremer-Cotter-Booker Association

Deep, nearly level, well drained, poorly drained, and very poorly drained soils that formed in alluvium; on flood plains

This association is on the wide flood plains along the Missouri River. It makes up about 14 percent of the survey area. It is about 43 percent Bremer soils, 27 percent Cotter soils, 19 percent Booker and similar soils, and 11 percent minor soils.

Bremer soils are poorly drained. They are in the slightly higher areas on the flood plains but are in landscape positions slightly lower than those of the Cotter soils. Typically, the surface layer is black silty clay loam. The upper part of the subsoil is very dark gray, mottled silty clay. The next part is dark grayish brown, mottled silty clay. The lower part is grayish brown, mottled silty clay loam.

Cotter soils are well drained. They are in the higher areas on the flood plains. Typically, the surface layer and subsurface layer are black silt loam. The upper part of the subsoil is black and dark brown silty clay loam. The lower part is brown silt loam.

Booker soils are very poorly drained. They are in the lower areas on the flood plains. Typically, the surface layer is black silty clay. The upper part of the subsoil is black clay. The lower part is very dark gray and gray, mottled clay.

Of minor extent in this association are Nodaway and Norborne soils. Nodaway soils are moderately well drained. They are along creeks that flow through the Missouri River bottoms. Norborne soils are well drained and are in the higher areas. They have more sand than the Cotter soils.

Growing grain crops is the main agricultural enterprise in areas of this association. Soybeans, wheat, and corn are the major crops. The wetness and a high content of clay are the main management concerns in areas of the Bremer and Booker soils.

The Cotter and Bremer soils are suited to building site development and sanitary facilities if construction sites are in areas above the flood level. A high shrink-swell potential, the wetness, seepage, restricted permeability, low strength, and the potential for frost action are the major limitations. The Booker and similar soils generally are unsuited to building site development and sanitary facilities because of the flooding.

6. Leta-Haynie-Waldron Association

Deep, nearly level, somewhat poorly drained and moderately well drained soils that formed in calcareous alluvium; on flood plains

This association is on the wide flood plains along the Missouri River. It makes up about 12 percent of the survey area. It is about 33 percent Leta and similar soils, 22 percent Haynie and similar soils, 21 percent Waldron soils, and 24 percent minor soils.

Leta soils are somewhat poorly drained. They are in the lower areas on the flood plains. Typically, the surface layer is very dark gray silty clay. The subsoil is very dark grayish brown, mottled silty clay that has strata of silt loam. The substratum is stratified dark grayish brown, very dark grayish brown, and brown, mottled very fine sandy loam and silt loam.

Haynie soils are moderately well drained. They are in the slightly higher positions on the flood plains. Typically, the surface layer is very dark grayish brown very fine sandy loam. The upper part of the substratum is dark grayish brown, stratified very fine sandy loam. The lower part is dark grayish brown, mottled silt loam that has strata of silty clay loam.

Waldron soils are somewhat poorly drained. They are in the lower areas on the flood plains, in landscape positions slightly lower than those of the Leta soils. Typically, the surface layer is very dark grayish brown silty clay loam. The upper part of the substratum is very dark gray and very dark grayish brown, mottled silty clay that has strata of dark grayish brown very fine sandy loam. The lower part is very dark grayish brown, mottled silty clay loam that has strata of brown and dark grayish brown very fine sandy loam.

Of minor extent in this association are Gilliam and Waubonsie soils. These soils are in the lower areas. Gilliam soils are somewhat poorly drained. Waubonsie soils are loamy in the upper part and loamy or clayey in the lower part.

Growing grain crops is the main agricultural enterprise in areas of this association. Soybeans,

wheat, and corn are the major crops. The wetness and a high content of clay are the main management concerns in areas of the Leta and Waldron soils.

This association generally is unsuited to building site development and sanitary facilities because of the flooding.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can help to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under the heading "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series.* Except for differences in texture of the surface layer or of the substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases.* Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Armster loam, 5 to 9 percent slopes, is a phase of the Armster series.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

The descriptions, names, and delineations of soils identified on the detailed soil maps in this survey do not fully agree with those of the soils identified on the maps of adjacent counties published at a different date. Differences are the result of additional soil data, variations in the intensity of mapping, and correlation decisions that reflect local conditions. In some areas combining small acreages of similar soils that respond to use and management in much the same way is more practical than mapping these soils separately.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The "Glossary" defines many of the terms used in describing the soils.

Soil Descriptions

01B—Lagonda silt loam, 2 to 5 percent slopes. This deep, gently sloping, somewhat poorly drained soil is on ridgetops in the uplands. Individual areas are irregular in shape and range from about 10 to more than 1,200 acres in size.

Typically, the surface layer is black, friable silt loam about 7 inches thick. The subsurface layer is black, friable silty clay loam about 4 inches thick. The subsoil is about 49 inches thick. The upper part is dark grayish brown, friable silty clay loam; the next part is dark grayish brown, mottled, firm and very firm silty clay loam and silty clay; and the lower part is grayish brown, mottled, very firm silty clay and clay. In some areas the lower part of the subsoil has less sand. In other areas the dark surface soil is thinner.

Included with this soil in mapping are small areas of the moderately well drained Sharpsburg soils. These soils are on the narrower, slightly higher ridgetops. They make up about 5 to 10 percent of the unit.

Permeability is slow in the Lagonda soil. Surface runoff is medium in cultivated areas. Natural fertility is high, and organic matter content is moderate. Available water capacity is high. The seasonal high water table commonly is at a depth of 1.5 to 3.0 feet during winter and spring. The shrink-swell potential is high. The surface layer is friable. It becomes cloddy, however, if

tilled when wet. Also, it can crust or puddle, especially after heavy rainfall.

Most areas are used for cultivated crops, pasture, or hay. This soil is suited to corn, soybeans, small grain, and grain sorghum. If cultivated crops are grown, erosion is a hazard. A conservation tillage system that leaves a protective cover of crop residue on the surface, crop rotations that include grasses and legumes, and winter cover crops help to prevent excessive soil loss. Most areas can be terraced and farmed on the contour. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

This soil is well suited to most of the commonly grown legumes, such as ladino clover and alsike clover; to cool-season grasses, such as timothy and reed canarygrass; and to warm-season grasses, such as big bluestem and switchgrass. The species that are tolerant of the wetness grow best. Erosion during seedbed preparation is the main problem. Tilling in a timely manner and establishing a ground cover as soon as possible help to prevent excessive soil loss.

This soil is suited to building site development. The shrink-swell potential and the wetness are limitations on sites for dwellings. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand and gravel help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excessive wetness around the foundations and basement walls and helps to keep basements dry.

This soil generally is unsuitable as a site for septic tank absorption fields because of the slow permeability and the wetness. Sewage lagoons function adequately if the site is leveled.

Low strength, the potential for frost action, and the shrink-swell potential are limitations on sites for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate roadside ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IIe.

02C2—Lagonda silty clay loam, 5 to 9 percent slopes, eroded. This deep, moderately sloping, somewhat poorly drained soil is on slightly concave side slopes in the uplands. Erosion has removed some of the original surface layer. Individual areas are irregular in shape and range from about 10 to more than 1,600 acres in size.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 7 inches thick. The subsoil extends to a depth of 60 inches or more. It is mottled and very firm. The upper part is dark grayish brown, firm silty clay, and the lower part is gray and grayish brown, very firm silty clay and clay. In some areas the lower part of the subsoil has less sand.

Included with this soil in mapping are small areas of Armster and Greenton soils. Armster soils are moderately well drained. They are on the ends of ridges and on convex side slopes. Greenton soils developed in residual material weathered from shale and are on low side slopes along small drainageways. Also included are some areas of severely eroded soils that have a dark grayish brown surface layer. Included soils make up about 5 to 10 percent of the unit.

Permeability is slow in the Lagonda soil. Surface runoff is medium in cultivated areas. Natural fertility is medium, and organic matter content is moderately low. Available water capacity is high. The seasonal high water table commonly is at a depth of 1.5 to 3.0 feet during winter and spring. The shrink-swell potential is high. The surface layer is friable. It becomes cloddy if tilled when wet. Also, it can crust or puddle after heavy rainfall, especially in areas where the plow layer contains subsoil material.

Most areas are used for cultivated crops, pasture, or hay. This soil is suited to corn, soybeans, small grain, and grain sorghum. If cultivated crops are grown, further erosion is a hazard. A conservation tillage system that leaves a protective cover of crop residue on the surface, crop rotations that include grasses and legumes, winter cover crops, and grassed waterways help to prevent excessive soil loss. Many areas can be terraced and farmed on the contour. Special management is needed if the clayey subsoil is exposed when terraces are constructed. The subsoil cannot be easily tilled. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

This soil is well suited to most of the commonly grown legumes, such as ladino clover and alsike clover; to cool-season grasses, such as timothy and reed canarygrass (fig. 5); and to warm-season grasses, such as big bluestem and switchgrass. The species that are tolerant of the wetness grow best. Erosion during seedbed preparation is the main problem. Tilling in a timely manner and establishing a ground cover as soon as possible help to prevent excessive soil loss.

This soil is suited to building site development. The shrink-swell potential and the wetness are limitations on

Figure 5.—Cattle in a pasture of cool-season grasses on Lagonda silty clay loam, 5 to 9 percent slopes, eroded.

sites for dwellings. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand and gravel help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excessive wetness around the foundations and basement walls and helps to keep basements dry.

This soil generally is unsuitable as a site for septic tank absorption fields because of the slow permeability and the wetness. Sewage lagoons function adequately if the site is leveled.

Low strength, the potential for frost action, and the shrink-swell potential are limitations on sites for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate roadside ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IIIe.

03B—Armster loam, 2 to 5 percent slopes. This deep, gently sloping, moderately well drained soil is on ridgetops in the uplands. Individual areas generally are long and narrow and range from about 10 to 50 acres in size.

Typically, the surface layer is very dark grayish brown, friable loam about 8 inches thick. The subsoil extends to a depth of more than 60 inches. It is firm and very firm. The upper part is dark yellowish brown,

mottled clay loam and clay; the next part is yellowish brown and strong brown, mottled clay; and the lower part is multicolored clay loam. In some areas the soil has less sand and does not have red mottles.

Permeability is moderately slow. Surface runoff is medium. Natural fertility also is medium, and organic matter content is moderately low. Available water capacity is high. The seasonal high water table is at a depth of 3 to 5 feet during winter and spring. The shrink-swell potential is high. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. It tends to crust or puddle, however, after heavy rainfall.

Most areas are used for cultivated crops, pasture, or hay. This soil is suited to corn, soybeans, small grain, and grain sorghum. If cultivated crops are grown, erosion is a hazard. A conservation tillage system that leaves a protective cover of crop residue on the surface, crop rotations that include grasses and legumes, and winter cover crops help to prevent excessive soil loss. Some areas can be terraced and farmed on the contour. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to prevent surface crusting.

This soil is well suited to most of the commonly grown legumes, such as alfalfa and red clover; to cool-season grasses, such as bromegrass and orchardgrass; and to warm-season grasses, such as big bluestem and switchgrass. No serious problems affect pasture or hayland. Erosion is a hazard in newly seeded areas. Timely seedbed preparation helps to ensure a good ground cover.

A few areas support native hardwoods. This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

This soil is suited to building site development. The shrink-swell potential and the wetness are limitations on sites for dwellings. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand and gravel help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excessive wetness around the foundations and basement walls and helps to keep basements dry.

This soil generally is unsuitable as a site for septic tank absorption fields because of the wetness and the moderately slow permeability. The slope and the wetness are limitations on sites for sewage lagoons. The less sloping areas, where less leveling is needed, should be selected as sites for the lagoons. Sealing the lagoons with slowly permeable material helps to prevent the contamination of ground water.

Low strength, the potential for frost action, and the shrink-swell potential are limitations on sites for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate roadside ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IIe. The woodland ordination symbol is 4A.

03C—Armster loam, 5 to 9 percent slopes. This deep, moderately sloping, moderately well drained soil is on convex side slopes and narrow ridgetops in the uplands. Individual areas are irregular in shape and range from about 10 to 640 acres in size.

Typically, the surface layer is very dark grayish brown, friable loam about 6 inches thick. The subsoil extends to a depth of 60 inches or more. The upper part is brown and dark yellowish brown, mottled, friable clay loam; the next part is dark yellowish brown, mottled, firm clay; and the lower part is mottled strong brown, light brownish gray, and yellowish brown, firm clay and clay loam. In some areas on narrow ridgetops, the slope is less than 5 percent.

Included with this soil in mapping are small areas of the somewhat poorly drained Greenton and Lagonda soils. Greenton soils are lower on the side slopes. Lagonda soils are at the head of drainageways. Also included are areas of eroded soils that have a surface layer of brown clay loam. Included soils make up about 5 to 10 percent of the unit.

Permeability is moderately slow in the Armster soil. Surface runoff is medium. Natural fertility also is medium, and organic matter content is moderately low. Available water capacity is high. The seasonal high water table commonly is at a depth of 3 to 5 feet during winter and spring. The shrink-swell potential is high. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. It tends to crust or puddle, however, after heavy rainfall, especially in areas where the plow layer contains subsoil material.

Most areas are used for cultivated crops, pasture, or hay. A small acreage is used for woodland. This soil is suited to corn, soybeans, small grain, and grain sorghum. If cultivated crops are grown, erosion is a hazard. A conservation tillage system that leaves a protective cover of crop residue on the surface, crop rotations that include grasses and legumes, and winter cover crops help to prevent excessive soil loss. Many areas can be terraced and farmed on the contour.

Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to prevent surface crusting.

This soil is well suited to most of the commonly grown legumes, such as alfalfa and red clover; to cool-season grasses, such as bromegrass and orchardgrass; and to warm-season grasses, such as big bluestem and switchgrass. No serious problems affect pasture or hayland. Erosion is a hazard in newly seeded areas. Timely seedbed preparation helps to ensure a good ground cover.

A few areas support native hardwoods. This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

This soil is suited to building site development. The shrink-swell potential and the wetness are limitations on sites for dwellings. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand and gravel help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excessive wetness around the foundations and basement walls and helps to keep basements dry.

This soil generally is unsuitable as a site for septic tank absorption fields because of the wetness and the moderately slow permeability. The slope and the wetness are limitations on sites for sewage lagoons. The less sloping areas, where less leveling is needed, should be selected as sites for the lagoons. Sealing the lagoons with slowly permeable material helps to prevent the contamination of ground water.

Low strength, the potential for frost action, and the shrink-swell potential are limitations on sites for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate roadside ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IIIe. The woodland ordination symbol is 4A.

04C2—Armster clay loam, 5 to 9 percent slopes, eroded. This deep, moderately sloping, moderately well drained soil is on convex side slopes in the uplands. Erosion has removed some of the original surface layer. Individual areas are irregular in shape and range from about 10 to 180 acres in size.

Typically, the surface layer is brown, friable clay loam about 6 inches thick. It is a mixture of subsoil material and surface soil material. The subsoil to a depth of 60 inches or more is firm and very firm, mottled clay loam or clay. The upper part is dark yellowish brown, the next part is yellowish brown and strong brown, and the lower part is yellowish red. In some areas the surface layer is very dark grayish brown loam or silt loam. In other areas the subsoil is silty clay loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Greenton and Lagonda soils. Greenton soils are lower on the side slopes than the Armster soil. Lagonda soils are at the head of drainageways. Also included are areas of severely eroded soils that have a surface layer that is thinner than that of the Armster soil. Included soils make up about 10 to 15 percent of the unit.

Permeability is moderately slow in the Armster soil. Surface runoff is rapid. Natural fertility and organic matter content are low. Available water capacity is moderate. The seasonal high water table commonly is at a depth of 3 to 5 feet during winter and spring. The shrink-swell potential is high. The surface layer is friable but can be easily tilled only within a narrow range in moisture content. It becomes cloddy if tilled when wet and can crust after heavy rainfall.

Most areas are used for cultivated crops, pasture, or hay (fig. 6). This soil is suited to cultivated crops if the crops are grown on a limited basis in rotation with close-growing pasture or hay crops. If cultivated crops are grown, further erosion is a hazard. A conservation tillage system that leaves a protective cover of crop residue on the surface, crop rotations that include grasses and legumes, and winter cover crops help to prevent excessive soil loss. Many areas can be terraced and farmed on the contour. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

This soil is well suited to most of the commonly grown legumes, such as alfalfa and red clover; to cool-season grasses, such as bromegrass and orchardgrass; and to warm-season grasses, such as big bluestem and switchgrass. No serious problems affect pasture or hayland. Erosion is a hazard in newly seeded areas. Timely seedbed preparation helps to ensure a good ground cover.

This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

This soil is suited to building site development. The shrink-swell potential and the wetness are limitations on sites for dwellings. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand and gravel help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and

Figure 6.—A field of milo and an abandoned farmstead on Armster clay loam, 5 to 9 percent slopes, eroded.

gravel helps to prevent the damage caused by excessive wetness around the foundations and basement walls and helps to keep basements dry.

This soil generally is unsuitable as a site for septic tank absorption fields because of the wetness and the moderately slow permeability. The slope and the wetness are limitations on sites for sewage lagoons. The less sloping areas, where less leveling is needed, should be selected as sites for the lagoons. Sealing the lagoons with slowly permeable material helps to prevent the contamination of ground water.

Low strength, the potential for frost action, and the shrink-swell potential are limitations on sites for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate roadside ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IIIe. The woodland ordination symbol is 4A.

04D3—Armster clay loam, 9 to 14 percent slopes, severely eroded. This deep, strongly sloping, moderately well drained soil is on convex side slopes in the uplands. Erosion has removed most of the original dark surface soil. Individual areas are irregular in shape and range from about 10 to 115 acres in size.

Typically, the surface layer is brown, friable clay loam about 2 inches thick. The subsoil is mottled. It is 58 inches or more thick. The upper part is dark yellowish brown, very firm clay; the next part is strong brown, very firm clay; and the lower part is yellowish brown,

firm clay loam. In some of the less eroded areas, the surface layer is very dark grayish brown loam. In other areas the slope is less than 9 percent.

Included with this soil in mapping are small areas of the moderately deep Gosport and somewhat poorly drained Greenton soils. These soils are lower on the side slopes than the Armster soil. Included soils make up about 5 to 10 percent of the unit.

Permeability is moderately slow in the Armster soil. Surface runoff is rapid. Natural fertility and organic matter content are low. Available water capacity is moderate. The seasonal high water table commonly is at a depth of 3 to 5 feet during winter and spring. The shrink-swell potential is high. The surface layer is friable but can be easily tilled only within a narrow range in moisture content.

Most areas are used for pasture or hay. This soil is unsuited to cultivated crops because of the slope and the severe hazard of erosion; however, a few areas are cultivated along with adjacent, less sloping areas.

This soil is suited to most of the commonly grown legumes, such as ladino clover and red clover; to cool-season grasses, such as tall fescue and timothy; and to warm-season grasses, such as big bluestem and switchgrass. Erosion during seedbed preparation and overgrazing are the main management problems. Timely seedbed preparation helps to ensure a good ground cover. Measures that maintain fertility and control brush are necessary management practices.

This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

This soil is suited to building site development. The shrink-swell potential, the wetness, and the slope are limitations on sites for dwellings. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand and gravel help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excessive wetness around the foundations and basement walls and helps to keep basements dry. The slope can be overcome by land shaping or by designing the buildings so that they conform to the natural slope of the land.

This soil generally is unsuitable as a site for septic tank absorption fields because of the wetness and the moderately slow permeability. The slope and the wetness are limitations on sites for sewage lagoons. The less sloping areas, where less leveling is needed, should be selected as sites for the lagoons. Sealing the lagoons with slowly permeable material helps to prevent the contamination of ground water.

Low strength, the potential for frost action, the shrink-swell potential, and the slope are limitations on sites for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate roadside ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength. The slope can be overcome by building on the contour.

The land capability classification is VIe. The woodland ordination symbol is 4A.

05B—Grundy silt loam, 2 to 5 percent slopes. This deep, gently sloping, somewhat poorly drained soil is on ridgetops and saddles in the uplands. Individual areas are irregular in shape and range from about 10 to more than 2,100 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 8 inches thick. The subsurface layer is very dark grayish brown, friable silty clay loam about 5 inches thick. The subsoil extends to a depth of 60 inches or more. It is mottled and very firm and firm. The upper part is dark grayish brown silty clay, the next part is grayish brown silty clay, and the lower part is grayish brown silty clay loam. In some areas the subsurface layer is dark grayish brown silt loam. In a few areas the lower part of the subsoil has more sand and some pebbles.

Included with this soil in mapping are small areas of the moderately well drained Sharpsburg soils on ridgetops. These soils generally are higher on the landscape than the Grundy soil. Also included are areas of eroded soils that have a surface layer that is silty clay loam and is thinner than that of the Grundy soil. Included soils make up about 5 to 10 percent of the unit.

Permeability is slow in the Grundy soil. Surface runoff is medium. Natural fertility is high, and organic matter content is moderate. Available water capacity is high. The seasonal high water table commonly is at a depth of 1.5 to 3.0 feet during the spring. The shrink-swell potential is high. The surface layer is friable. It becomes cloddy, however, if tilled when wet. Also, it can crust or puddle, especially after heavy rainfall. Because of the slow permeability and the wetness, tillage is delayed in most years, especially in early spring.

Most areas are used for cultivated crops. A small acreage is used for pasture or hay. This soil is suited to corn, soybeans, small grain, and grain sorghum. If cultivated crops are grown, erosion is a hazard. A conservation tillage system that leaves a protective cover of crop residue on the surface, crop rotations that include grasses and legumes, and winter cover crops help to prevent excessive soil loss. Most areas can be

terraced and farmed on the contour. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the rate of water infiltration.

This soil is well suited to most of the commonly grown legumes, such as ladino clover and alsike clover; to cool-season grasses, such as timothy and reed canarygrass; and to warm-season grasses, such as big bluestem and switchgrass. The species that are tolerant of the wetness grow best. Erosion during seedbed preparation is the main problem. Tilling in a timely manner and establishing a ground cover as soon as possible help to prevent excessive soil loss.

This soil is suited to building site development. The shrink-swell potential and the wetness are limitations on sites for dwellings. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand and gravel help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excessive wetness around the foundations and basement walls and helps to keep basements dry.

This soil generally is unsuitable as a site for septic tank absorption fields because of the wetness and the slow permeability. Sewage lagoons function adequately if the site is leveled.

Low strength, the potential for frost action, and the shrink-swell potential are limitations on sites for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate roadside ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IIe.

07C2—Knox silt loam, 5 to 9 percent slopes, eroded. This deep, well drained, moderately sloping soil is on ridgetops and side slopes in the uplands bordering flood plains along the Missouri River. Erosion has removed some of the original surface layer. Individual areas typically are long and narrow and range from about 10 to 500 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 6 inches thick. The subsoil is brown and dark yellowish brown, firm silty clay loam about 40 inches thick. It is mottled in the lower part. The substratum to a depth of 60 inches or more is brown, mottled, friable silt loam. In some areas the slope is less than 5 percent. In a few areas the upper part of the subsoil has grayish mottles.

Included with this soil in mapping are small areas of Higginsville and Wakenda soils. Higginsville soils are somewhat poorly drained and are at the head of drainageways. Wakenda soils have a dark surface layer that is more than 10 inches thick. They are on ridgetops that are upslope from the Knox soil. Also included are some areas of severely eroded soils that have a surface layer of brown silty clay loam. Included soils make up 5 to 10 percent of the unit.

Permeability is moderate in the Knox soil. Surface runoff is medium. Natural fertility is high, and organic matter content is moderately low. Available water capacity is high. The shrink-swell potential is moderate. The surface layer is friable and can be easily tilled, but it tends to puddle or crust after heavy rainfall.

Most areas are used for cultivated crops, pasture, or hay. A small acreage is used for woodland. This soil is suited to corn, soybeans, grain sorghum, and small grain. If cultivated crops are grown, further erosion is a hazard. A conservation tillage system that leaves a protective cover of crop residue on the surface, crop rotations that include grasses and legumes, winter cover crops, and grassed waterways help to prevent excessive soil loss. Some areas can be terraced and farmed on the contour. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

This soil is well suited to most of the commonly grown legumes, such as alfalfa and red clover; to cool-season grasses, such as smooth brome and orchardgrass; and to warm-season grasses, such as big bluestem and switchgrass. No serious problems affect pasture or hayland. Erosion is a hazard in newly seeded areas. Timely seedbed preparation helps to ensure a good ground cover.

A few areas support native hardwoods. This soil is suited to trees. No limitations or hazards affect planting or harvesting.

This soil is suited to building site development. The shrink-swell potential is a limitation on sites for buildings. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand and gravel help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excess water in areas where surface drainage is poor and gutters fail.

Septic tank systems function well in areas of this soil if they are properly installed. The slope and seepage are limitations on sites for sewage lagoons. The less sloping areas, where less leveling is needed, should be

selected as sites for the lagoons. Sealing the lagoons with slowly permeable material helps to prevent the contamination of ground water.

Low strength, the potential for frost action, and the shrink-swell potential are limitations on sites for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate roadside ditches, and installing culverts in low areas improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IIIe. The woodland ordination symbol is 4A.

07E2—Knox silt loam, 14 to 20 percent slopes, eroded. This deep, well drained, moderately steep soil is on the strongly dissected uplands bordering flood plains along the Missouri River. Erosion has removed some of the original surface layer. Individual areas are irregular in shape and range from about 15 to 200 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 5 inches thick. The subsoil is firm silty clay loam about 43 inches thick. The upper part is brown, and the lower part is brown and dark yellowish brown. The substratum to a depth of 60 inches or more is dark yellowish brown, mottled, friable silt loam. In some areas the slope is less than 14 percent or more than 20 percent.

Included with this soil in mapping are small areas of the somewhat poorly drained Greenton and moderately deep Gosport soils. These soils are on the lower side slopes. Also included are some areas of severely eroded soils that have a surface layer of brown silty clay loam. Included soils make up about 10 to 15 percent of the unit.

Permeability is moderate in the Knox soil. Surface runoff is rapid. Natural fertility is medium, and organic matter content is moderately low. Available water capacity is high. The shrink-swell potential is moderate. The surface layer is friable and can be easily tilled, but it tends to puddle or crust after heavy rainfall.

Most areas are used for pasture or woodland. Because of the slope, this soil can be used as cropland only on a very limited basis. A conservation tillage system that leaves a large amount of crop residue on the surface helps to prevent excessive soil loss.

This soil is suited to such commonly grown legumes as alfalfa and red clover, to such cool-season grasses as smooth brome and orchardgrass, and to such warm-season grasses as big bluestem and switchgrass. Erosion during seedbed preparation and overgrazing are the main management problems. A conservation tillage system that leaves a protective cover of crop residue on the surface helps to control erosion when the pasture or hayland is reestablished or renovated. Measures that prevent the formation of livestock paths up and down the slope help to keep gullies from forming. Overgrazing or grazing when the soil is wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates and pasture rotation improve pastures.

Some areas support native hardwoods. This soil is suited to trees. The hazard of erosion, the equipment limitation, and the seedling mortality rate are the main management concerns. In the steepest areas, logs should be yarded uphill to the roads or trails. Disturbed areas should be seeded after the trees are harvested. Establishing logging roads and skid trails on the contour helps to control erosion and ensure the safe operation of equipment. Selecting planting stock that is larger than normal increases the seedling survival rate.

This soil is suited to building site development. The shrink-swell potential and the slope are limitations on sites for buildings. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand and gravel help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excess water in areas where surface drainage is poor and gutters fail. The slope can be overcome by land shaping or by designing the buildings so that they conform to the natural slope of the land.

If this soil is used as site for a septic tank absorption field, the slope is a limitation. It can be overcome, however, by installing laterals across the slope. The slope and seepage are limitations on sites for sewage lagoons. The less sloping areas, where less leveling is needed, should be selected as sites for the lagoons. Sealing the lagoons with slowly permeable material helps to prevent the contamination of ground water.

Low strength, the potential for frost action, the shrink-swell potential, and the slope are limitations on sites for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate roadside ditches, and installing culverts in low areas improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength. The slope can be overcome by building on the contour.

The land capability classification is IVe. The woodland ordination symbol is 4R.

07F—Knox silt loam, 20 to 30 percent slopes. This deep, well drained, steep soil is on the strongly dissected uplands bordering flood plains along the Missouri River. Individual areas are irregular in shape and range from about 10 to 380 acres in size.

Typically, the surface layer is very dark grayish brown and dark brown, friable silt loam about 7 inches thick. The subsoil is brown and dark yellowish brown, firm silty clay loam about 39 inches thick. The substratum to a depth of 60 inches or more is yellowish brown and dark yellowish brown, friable silt loam. In some areas the slope is less than 20 percent or more than 30 percent.

Included with this soil in mapping are small areas of the moderately well drained Nodaway and moderately deep Gosport soils. Nodaway soils are on narrow flood plains. Gosport soils are on the lower side slopes. Also included are some areas of severely eroded soils that have a surface layer of brown silty clay loam. Included soils make up about 5 to 10 percent of the unit.

Permeability is moderate in the Knox soil. Surface runoff is rapid. Natural fertility is medium, and organic matter content is moderately low. Available water capacity is high. The shrink-swell potential is moderate. The surface layer is friable.

Most areas are used for woodland. This soil is suited to trees. The hazard of erosion, the equipment limitation, and the seedling mortality rate are the main management concerns. In the steepest areas, logs should be yarded uphill to the roads or trails. Disturbed areas should be seeded after the trees are harvested. Establishing logging roads and skid trails on the contour helps to control erosion and ensure the safe operation of equipment. Selecting planting stock that is larger than normal increases the seedling survival rate.

This soil is suited to most of the commonly grown legumes, such as alfalfa and red clover; to cool-season grasses, such as tall fescue and timothy; and to warm-season grasses, such as big bluestem and switchgrass. Because of the slope and the severe hazard of erosion, however, careful management is needed when pastures are reestablished. A conservation tillage system that leaves a large amount of crop residue on the surface helps to control erosion when pastures are seeded or renovated. Preparing the seedbed in strips that follow the contour also helps to control erosion. Measures that prevent the formation of livestock paths up and down the slope help to keep gullies from forming. Proper stocking rates and pasture rotation improve pastures. Measures that maintain fertility and control brush are necessary management practices.

This soil generally is not used for building site development or onsite waste disposal systems because of the slope.

The land capability classification is VIe. The woodland ordination symbol is 4R.

08D3—Knox silty clay loam, 9 to 14 percent slopes, severely eroded. This deep, strongly sloping, well drained soil is on the convex side slopes of the strongly dissected uplands bordering flood plains along the Missouri River. Erosion has removed most of the original dark surface layer. Individual areas are irregular in shape and range from about 10 to 180 acres in size.

Typically, the surface layer is brown, friable silty clay loam about 4 inches thick. It is a mixture of subsoil material and surface soil material. The subsoil is dark yellowish brown, friable and firm silty clay loam about 50 inches thick. The upper part is firm, and the lower part is mottled and friable. The substratum to a depth of 60 inches or more is dark yellowish brown, mottled, friable silt loam. In some of the less eroded areas, the surface layer is very dark grayish brown silt loam. In other areas the slope is less than 9 percent.

Included with this soil in mapping are small areas of the somewhat poorly drained Greenton and Higginsville soils. Greenton soils are on the lower side slopes. Higginsville soils are at the head of drainageways. Included soils make up about 2 to 5 percent of the unit.

Permeability is moderate in the Knox soil. Surface runoff is rapid. Natural fertility is medium, and organic matter content is low. Available water capacity is high. The shrink-swell potential is moderate. The surface layer is friable but becomes cloddy if tilled when wet.

Most areas are used for cultivated crops, hay, or pasture. This soil is suited to limited production of cultivated crops, but further severe erosion is a hazard if the soil is cultivated. A conservation tillage system that leaves crop residue on the surface, crop rotations that include grasses and legumes, winter cover crops, and grassed waterways help to prevent excessive soil loss. A few areas can be terraced and farmed on the contour. Returning a large amount of crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, increases the rate of water infiltration, and helps to prevent further severe erosion.

This soil is well suited to most of the commonly grown legumes, such as alfalfa and red clover; to cool-season grasses, such as tall fescue and timothy; and to warm-season grasses, such as big bluestem and switchgrass. Erosion during seedbed preparation and overgrazing are the main management problems. Timely seedbed preparation helps to ensure a good ground cover. Measures that maintain fertility and control brush are necessary management practices.

A few areas support native hardwoods. This soil is

suited to trees. No limitations or hazards affect planting or harvesting.

This soil is suited to building site development. The shrink-swell potential and the slope are limitations on sites for buildings. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand and gravel help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excess water in areas where surface drainage is poor and gutters fail. The slope can be overcome by land shaping or by designing the buildings so they conform to the natural slope of the land.

If this soil is used as a site for a septic tank absorption field, the slope is a limitation. It can be overcome, however, by installing laterals across the slope. The slope and seepage are limitations on sites for sewage lagoons. The less sloping areas, where less leveling is needed, should be selected as sites for the lagoons. Sealing the lagoons with slowly permeable material helps to prevent the contamination of ground water.

Low strength, the potential for frost action, the shrink-swell potential, and the slope are limitations on sites for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate roadside ditches, and installing culverts in low areas improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength. The slope can be overcome by building on the contour.

The land capability classification is IVe. The woodland ordination symbol is 4A.

09B—Sharpsburg silt loam, 2 to 5 percent slopes. This deep, gently sloping, moderately well drained soil is on convex ridgetops in the uplands. Individual areas generally are long and narrow and range from about 15 to more than 500 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 10 inches thick. The subsurface layer is dark brown, friable silty clay loam about 5 inches thick. The subsoil to a depth of 60 inches or more is firm silty clay loam. The upper part is brown, and the lower part is dark yellowish brown and brown and is mottled. In some areas the dark surface layer is thinner.

Included with this soil in mapping are small areas of the somewhat poorly drained Grundy soils. These soils are on the broader, flatter ridges at the slightly lower elevations. They make up about 5 to 10 percent of the unit.

Permeability is moderately slow in the Sharpsburg soil. Surface runoff is medium. Natural fertility is high, and organic matter content is moderate. Available water capacity is high. The seasonal high water table commonly is at a depth of 3 to 5 feet during most winter and spring months. The shrink-swell potential is moderate. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. It tends to crust or puddle, however, after heavy rainfall.

Most areas are used for cultivated crops, pasture, or hay. This soil is suited to corn, soybeans, grain sorghum, and small grain. If cultivated crops are grown, erosion is a hazard. A conservation tillage system that leaves crop residue on the surface, crop rotations that include grasses and legumes, and winter cover crops help to prevent excessive soil loss. Some areas can be terraced and farmed on the contour. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

This soil is well suited to most of the commonly grown legumes, such as alfalfa and red clover; to cool-season grasses, such as smooth brome and orchardgrass; and to warm-season grasses, such as big bluestem, indiangrass, and switchgrass. No serious problems affect pasture or hayland. Erosion is a hazard in newly seeded areas. Timely seedbed preparation helps to ensure a good ground cover.

This soil is suited to building site development. The shrink-swell potential is a limitation on sites for dwellings. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand and gravel help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excess water in areas where surface drainage is poor and gutters fail.

If this soil is used as a site for a septic tank absorption field, the moderately slow permeability is a limitation. It can be overcome, however, by enlarging the absorption field. The slope and seepage are limitations on sites for sewage lagoons. The less sloping areas, where less leveling is needed, should be selected as sites for the lagoons. Sealing the lagoons with slowly permeable material helps to prevent the contamination of ground water.

Low strength, the potential for frost action, and the shrink-swell potential are limitations on sites for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate roadside ditches, and installing culverts in low areas improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding

crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IIe.

09C2—Sharpsburg silt loam, 5 to 9 percent slopes, eroded. This deep, moderately sloping, moderately well drained soil is on convex side slopes in the uplands. Erosion has removed some of the original surface layer. Individual areas are irregular in shape and range from about 10 to more than 100 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 6 inches thick. The subsoil to a depth of 60 inches or more is silty clay loam. The upper part is brown and friable, and the lower part is dark yellowish brown, mottled, and firm. In some areas the dark surface layer is thicker.

Included with this soil in mapping are small areas of the somewhat poorly drained Lagonda soils. These soils are on the slightly concave slopes below the Sharpsburg soil and at the head of drainageways. Also included are some areas of severely eroded soils that have a surface layer of dark brown silty clay loam. Included soils make up about 5 to 10 percent of the unit.

Permeability is moderately slow in the Sharpsburg soil. Surface runoff is medium in cultivated areas. Natural fertility is high, and organic matter content is moderate. Available water capacity is high. The seasonal high water table commonly is at a depth of 3 to 5 feet during most winter and spring months. The shrink-swell potential is moderate. The surface layer is friable and can be easily tilled throughout a fairly wide range in moisture content. It tends to crust or puddle, however, after heavy rainfall, especially in areas where the plow layer contains subsoil material.

Most areas are used for cultivated crops, pasture, or hay. This soil is suited to corn, soybeans, grain sorghum, and small grain. If cultivated crops are grown, further erosion is a hazard. A conservation tillage system that leaves crop residue on the surface, crop rotations that include grasses and legumes, and winter cover crops help to prevent excessive soil loss. Many areas can be terraced and farmed on the contour. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

This soil is well suited to most of the commonly grown legumes, such as alfalfa and red clover; to cool-season grasses, such as smooth brome and orchardgrass; and to warm-season grasses, such as big bluestem, indiangrass, and switchgrass. No serious problems affect pasture or hayland. Erosion is a hazard in newly seeded areas. Timely seedbed preparation helps to ensure a good ground cover.

This soil is suited to building site development. The shrink-swell potential is a limitation on sites for dwellings. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand and gravel help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excess water in areas where surface drainage is poor and gutters fail.

If this soil is used as a site for a septic tank absorption field, the moderately slow permeability is a limitation. It can be overcome, however, by enlarging the absorption field. The slope and seepage are limitations on sites for sewage lagoons. The less sloping areas, where less leveling is needed, should be selected as sites for the lagoons. Sealing the lagoons with slowly permeable material helps to prevent the contamination of ground water.

Low strength, the potential for frost action, and the shrink-swell potential are limitations on sites for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate roadside ditches, and installing culverts in low areas improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IIIe.

11B—Ladoga silt loam, 2 to 5 percent slopes. This deep, moderately well drained, gently sloping soil is on convex ridgetops in the uplands. Individual areas generally are long and narrow and range from about 15 to more than 100 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 7 inches thick. The subsoil to a depth of 60 inches or more is brown, dark yellowish brown, and yellowish brown, firm and friable silty clay loam. The lower part is mottled. In some areas the dark surface layer is thicker. In other areas the upper part of the subsoil has gray mottles.

Permeability is moderately slow. Surface runoff is medium. Natural fertility also is medium, and organic matter content is moderate. Available water capacity is high. The shrink-swell potential is moderate. The surface layer is friable and can be easily worked, but it tends to crust or puddle after heavy rainfall.

Most areas are used for cultivated crops, pasture, or hay. A few areas are used for woodland. This soil is suited to corn, soybeans, grain sorghum, and small grain. If cultivated crops are grown, erosion is a hazard. A conservation tillage system that leaves crop residue

on the surface, crop rotations that include grasses and legumes, and winter cover crops help to prevent excessive soil loss. Some areas can be terraced and farmed on the contour. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

This soil is well suited to most of the commonly grown legumes, such as alfalfa and red clover; to cool-season grasses, such as smooth brome and orchardgrass; and to warm-season grasses, such as big bluestem, indiangrass, and switchgrass. No serious problems affect pasture or hayland. Erosion is a hazard in newly seeded areas. Timely seedbed preparation helps to ensure a good ground cover.

A few areas support native hardwoods. This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

This soil is suited to building site development. The shrink-swell potential is a limitation on sites for dwellings. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand and gravel help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excess water in areas where surface drainage is poor and gutters fail.

If this soil is used as a site for a septic tank absorption field, the moderately slow permeability is a limitation. It can be overcome, however, by enlarging the absorption field. The slope and seepage are limitations on sites for sewage lagoons. The less sloping areas, where less leveling is needed, should be selected as sites for the lagoons. Sealing the lagoons with slowly permeable material helps to prevent the contamination of ground water.

Low strength, the potential for frost action, and the shrink-swell potential are limitations on sites for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate roadside ditches, and installing culverts in low areas improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IIe. The woodland ordination symbol is 4A.

11C2—Ladoga silt loam, 5 to 9 percent slopes, eroded. This deep, moderately well drained, moderately sloping soil is on narrow ridgetops and side slopes in the uplands. Erosion has removed some of the original surface layer. Individual areas generally are irregular in shape and range from about 15 to 115 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 5 inches thick. The subsoil to a depth of 60 inches or more is silty clay loam. The upper part is brown and firm; the next part is brown, mottled, and firm; and the lower part is multicolored and is firm and friable. In some areas the slope is less than 5 percent.

Included with this soil in mapping are small areas of the somewhat poorly drained Greenton soils. They are on the lower side slopes and along drainageways. Also included are areas of severely eroded soils that have a surface layer of brown silty clay loam. Included soils make up about 5 to 10 percent of the unit.

Permeability is moderately slow in the Ladoga soil. Surface runoff is medium. Natural fertility also is medium, and organic matter content is moderate. Available water capacity is high. The shrink-swell potential is moderate. The surface layer is friable and can be easily tilled, but it tends to crust or puddle after heavy rainfall.

Most areas are used for cultivated crops, hay, or pasture. A few areas are used for woodland. This soil is suited to corn, soybeans, grain sorghum, and small grain. If cultivated crops are grown, further erosion is a hazard. A conservation tillage system that leaves crop residue on the surface, crop rotations that include grasses and legumes, and winter cover crops help to prevent excessive soil loss. Many areas can be terraced and farmed on the contour. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the rate of water infiltration.

This soil is well suited to most of the commonly grown legumes, such as alfalfa and red clover; to cool-season grasses, such as smooth brome and orchardgrass; and to warm-season grasses, such as big bluestem, indiangrass, and switchgrass. No serious problems affect pasture or hayland. Erosion is a hazard in newly seeded areas. Timely seedbed preparation helps to ensure a good ground cover.

A few areas support native hardwoods. This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

This soil is suited to building site development. The shrink-swell potential is a limitation on sites for dwellings. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand and gravel help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excess water in areas where surface drainage is poor and gutters fail.

If this soil is used as a site for a septic tank absorption field, the moderately slow permeability is a limitation. It can be overcome, however, by enlarging the absorption field. The slope and seepage are limitations on sites for sewage lagoons. The less sloping areas, where less leveling is needed, should be selected as sites for the lagoons. Sealing the lagoons with slowly permeable material helps to prevent the contamination of ground water.

Low strength, the potential for frost action, and the shrink-swell potential are limitations on sites for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate roadside ditches, and installing culverts in low areas improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IIIe. The woodland ordination symbol is 4A.

14C2—Greenton silty clay loam, 5 to 9 percent slopes, eroded. This deep, moderately sloping, somewhat poorly drained soil is on convex side slopes and foot slopes in the uplands. Erosion has removed some of the original surface layer. Individual areas are irregular in shape and range from about 10 to more than 1,000 acres in size.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 7 inches thick. The subsoil is mottled. It is about 34 inches thick. The upper part is brown, friable silty clay loam; the next part is dark yellowish brown and light olive brown, firm silty clay; and the lower part is yellowish brown, firm silty clay. The substratum to a depth of 60 inches or more is multicolored, firm silty clay. In some areas the slope is more than 9 percent. In other areas the soil has more sand.

Included with this soil in mapping are small areas of the moderately well drained Armster and Gosport soils. Also included are small areas of the poorly drained Sampsel soils. Armster soils are in narrow strips, in landscape positions higher than those of the Greenton soil. Gosport soils are moderately deep over bedrock. They are in narrow strips, in landscape positions higher or lower than those of the Greenton soil. Sampsel soils are at the head of drainageways. Also included are some areas of severely eroded soils that have a mixed brown and very dark grayish brown surface layer. Included soils make up about 5 to 15 percent of the unit.

Permeability is slow in the Greenton soil. Surface runoff is medium. Natural fertility also is medium, and organic matter content is moderately low. Available water capacity is moderate. The seasonal high water table commonly is at a depth of 1.5 to 3.0 feet during winter and spring. The shrink-swell potential is high. The surface layer is friable but becomes cloddy if tilled when the moisture content is high.

Most areas are used for cultivated crops, hay, or pasture. This soil is suited to corn, soybeans, grain sorghum, and small grain. If cultivated crops are grown, further erosion is a hazard. A conservation tillage system that leaves crop residue on the surface, crop rotations that include grasses and legumes, and winter cover crops help to prevent excessive soil loss. Many areas can be terraced and farmed on the contour. Special management is needed if the clayey subsoil is exposed where terraces are constructed. The subsoil cannot be easily tilled. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

This soil is well suited to most of the commonly grown legumes, such as alsike clover and lespedeza; to cool-season grasses, such as tall fescue and reed canarygrass; and to warm-season grasses, such as big bluestem and switchgrass. The species that are tolerant of the wetness grow best. Erosion during seedbed preparation is the main problem. Tilling in a timely manner and establishing a ground cover as soon as possible help to prevent excessive soil loss.

This soil is suited to building site development. The shrink-swell potential and the wetness are limitations on sites for dwellings. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand and gravel help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excessive wetness around the foundations and basement walls and helps to keep basements dry.

This soil generally is unsuitable as a site for septic tank absorption fields because of the wetness and the slow permeability. Sewage lagoons function adequately if the site is leveled.

Low strength, the potential for frost action, the shrink-swell potential, and the wetness are limitations on sites for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate roadside ditches, and installing culverts in low areas improve drainage and thus help to prevent the damage caused by frost action, shrinking and swelling, and wetness. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IIIe.

14D2—Greenton silty clay loam, 9 to 14 percent slopes, eroded. This deep, strongly sloping, somewhat poorly drained soil is on convex side slopes in the uplands. Erosion has removed some of the original surface layer. Individual areas are irregular in shape and range from about 10 to 200 acres in size.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 6 inches thick. The subsoil is about 45 inches thick. The upper part is brown, friable silty clay loam, and the lower part is dark yellowish brown and yellowish brown, mottled, firm silty clay and silty clay loam. The substratum to a depth of 60 inches or more is grayish brown, mottled, very firm silty clay. In some areas the slope is less than 9 percent. In other areas the soil has more sand.

Included with this soil in mapping are small areas of Gosport soils. These soils are moderately deep over bedrock. They are in narrow strips, in landscape positions higher or lower than those of the Greenton soil. Also included are some areas of severely eroded soils that have a surface layer that is thinner than that of the Greenton soil. Included soils make up about 5 to 10 percent of the unit.

Permeability is slow in the Greenton soil. Surface runoff is rapid. Natural fertility is medium, and organic matter content is moderately low. Available water capacity is moderate. The seasonal high water table commonly is at a depth of 1.5 to 3.0 feet during winter and spring. The shrink-swell potential is high. The surface layer is friable but becomes cloddy if worked when wet. It crusts or puddles after heavy rainfall, especially where the surface layer contains subsoil material.

Most areas are used for pasture or hay. This soil is unsuited to cultivated crops because of the slope and the severe hazard of erosion; however, a few areas are cultivated along with adjacent, less sloping areas.

This soil is suited to most of the commonly grown legumes, such as alsike clover and lespedeza; to cool-season grasses, such as tall fescue and reed canarygrass; and to warm-season grasses, such as big bluestem and switchgrass. The species that are tolerant of the wetness grow best. Erosion during seedbed preparation is the main problem. Tilling in a timely manner and establishing a ground cover as soon as possible help to prevent excessive soil loss.

This soil is suited to building site development. The shrink-swell potential, the wetness, and the slope are limitations on sites for dwellings. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand and gravel help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excessive wetness around the foundations and basement walls and helps to keep basements dry. The slope can be overcome by land shaping or by designing the buildings so that they conform to the natural slope of the land.

This soil generally is unsuitable as a site for septic tank absorption fields because of the wetness and the slow permeability. Sewage lagoons function adequately if they are built in the less sloping areas or if the site is leveled.

Low strength, the potential for frost action, the shrink-swell potential, the wetness, and the slope are limitations on sites for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate roadside ditches, and installing culverts in low areas improve drainage and thus help to prevent the damage caused by frost action, shrinking and swelling, and wetness. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength. The slope can be overcome by building on the contour.

The land capability classification is VIe.

16B—Sampsel silty clay loam, 2 to 5 percent slopes. This deep, gently sloping, poorly drained soil is on slightly concave foot slopes along drainageways. Individual areas are irregular in shape and range from about 10 to 100 acres in size.

Typically, the surface layer is very dark gray, friable silty clay loam about 5 inches thick. The subsurface layer is very dark gray, firm silty clay loam about 6 inches thick. The subsoil extends to a depth of 70 inches or more. It is firm and very firm. The upper part is very dark gray, mottled silty clay loam; the next part is dark grayish brown and grayish brown, mottled silty clay; and the lower part is grayish brown and olive gray, mottled silty clay loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Greenton and Grundy soils. Greenton soils are on the steeper side slopes near the drainageways. Grundy soils are on the slightly higher convex ridgetops. Also included are some areas of eroded soils that have a dark surface layer that is thinner than that of the Sampsel soil and, on the lower parts of the unit, seepy areas that stay wet most of the year. Included soils make up about 5 to 10 percent of the unit.

Permeability is slow in the Sampsel soil. Surface runoff is medium. Natural fertility also is medium, and organic matter content is moderate. Available water capacity is high. The seasonal high water table commonly is within a depth of 1.5 feet during winter and

spring. The shrink-swell potential is high. The surface layer can be tilled only within a narrow range in moisture content. If tilled when wet or dry, it becomes cloddy. Also, it becomes compacted if tilled when wet. The seepy areas stay wet most of the year.

Most areas are used for cropland. A few areas are used for pasture or hay. This soil is suited to corn, soybeans, and grain sorghum. If cultivated crops are grown, erosion is a hazard. Also, surface compaction is a problem in seepy areas. A conservation tillage system that leaves crop residue on the surface, crop rotations that include grasses and legumes, and winter cover crops help to prevent excessive soil loss. Most areas can be terraced and farmed on the contour. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface compaction, and increases the rate of water infiltration. Constructing diversion terraces on the upper part of the mapped areas helps to prevent seepage.

This soil is well suited to most of the commonly grown legumes, such as ladino clover and alsike clover; to cool-season grasses, such as timothy and reed canarygrass; and to warm-season grasses, such as big bluestem and switchgrass. The species that are tolerant of the wetness grow best. Erosion during seedbed preparation is the main problem. Tilling in a timely manner and establishing a ground cover as soon as possible help to prevent excessive soil loss.

This soil is suited to building site development. The shrink-swell potential and the wetness are limitations on sites for dwellings. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand and gravel help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excessive wetness around the foundations and basement walls and helps to keep basements dry.

This soil generally is unsuitable as a site for septic tank absorption fields because of the wetness and the slow permeability. Sewage lagoons function adequately if the site is leveled.

Low strength, the potential for frost action, the shrink-swell potential, and the wetness are limitations on sites for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate roadside ditches, and installing culverts in low areas improve drainage and thus help to prevent the damage caused by frost action, shrinking and swelling, and wetness. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IIe.

21B—Wakenda silt loam, 2 to 5 percent slopes. This deep, gently sloping, well drained soil is on moderately wide, convex ridgetops in the uplands and on high stream terraces. Individual areas are long and moderately wide and range from about 5 to 850 acres in size.

Typically, the surface layer is very dark grayish brown, very friable silt loam about 14 inches thick. The subsoil to a depth of 51 inches is silty clay loam. The upper part is very dark grayish brown and friable; the next part is brown and firm; and the lower part is brown, mottled, and friable. The substratum to a depth of 60 inches or more is brown, mottled, friable silt loam. In some areas gray mottles are within a depth of 36 inches. In other areas the surface layer is thinner or thicker.

Included with this soil in mapping are small areas of the somewhat poorly drained Higginsville soils. These soils are on concave side slopes below the Wakenda soil. They make up less than 5 percent of the unit.

Permeability is moderate in the Wakenda soil. Surface runoff is medium in cultivated areas. Natural fertility is high, and organic matter content is moderate. Available water capacity is very high. The seasonal high water table commonly is within a depth of 4 to 6 feet from late fall through spring. The shrink-swell potential is moderate. The surface layer is very friable and can be easily tilled throughout a moderately wide range in moisture content. It tends to crust or puddle, however, after heavy rainfall.

Most areas are used for cultivated crops. A few areas are used for pasture or hay. This soil is suited to corn, soybeans, grain sorghum, and small grain. If cultivated crops are grown, erosion is a hazard. A conservation tillage system that leaves crop residue on the surface, crop rotations that include grasses and legumes, and winter cover crops help to prevent excessive soil loss. Many areas can be terraced and farmed on the contour. Regularly returning crop residue to the soil helps to prevent surface crusting and increases the rate of water infiltration.

This soil is well suited to most of the commonly grown legumes, such as alfalfa and red clover; to cool-season grasses, such as smooth brome and orchardgrass; and to warm-season grasses, such as big bluestem, indiangrass, and switchgrass. No serious problems affect pasture or hayland. Erosion is a hazard in newly seeded areas. Timely seedbed preparation helps to ensure a good ground cover.

This soil is suited to building site development. The shrink-swell potential is a limitation on sites for dwellings. Constructing footings, foundations, and basement walls with adequately reinforced concrete and

backfilling with sand and gravel help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excess water in areas where surface drainage is poor and gutters fail.

Septic tank systems function adequately in areas of this soil if perimeter drains are installed around the absorption field to lower the water table. The slope and seepage are limitations on sites for sewage lagoons. The less sloping areas, where less leveling is needed, should be selected as sites for the lagoons. Sealing the lagoons with slowly permeable material helps to prevent the contamination of ground water.

Low strength, the potential for frost action, and the shrink-swell potential are limitations on sites for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate roadside ditches, and installing culverts in low areas improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IIe.

21C2—Wakenda silt loam, 5 to 9 percent slopes, eroded. This deep, moderately sloping, well drained soil is on convex side slopes and narrow ridgetops in the uplands. Erosion has removed some of the original surface layer. Individual areas are irregular in shape and range from about 10 to 195 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 10 inches thick. The subsoil is silty clay loam about 31 inches thick. The upper part is very dark grayish brown and friable; the next part is brown and friable; and the lower part is brown and dark yellowish brown, mottled, and firm. The substratum to a depth of about 60 inches or more is yellowish brown, mottled, friable silt loam. In some areas, grayish brown mottles are within a depth of 36 inches and the subsoil has more clay. In other areas the surface layer is silty clay loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Higginsville soils. These soils are at the head of drainageways and on the lower parts of the side slopes. Also included are some areas of severely eroded soils that have a surface layer that is thinner than that of the Wakenda soil. Included soils make up less than 5 percent of the unit.

Permeability is moderate in the Wakenda soil. Surface runoff is medium in cultivated areas. Natural fertility is high, and organic matter content is moderate. Available water capacity is very high. The seasonal high water table commonly is within a depth of 4 to 6 feet from late fall through spring. The shrink-swell potential is moderate. The surface layer is friable and can be easily tilled throughout a moderately wide range in moisture content. It crusts or puddles, however, after heavy rainfall.

Most areas are used for cultivated crops, but a few areas are used for pasture or hay. This soil is suited to corn, soybeans, grain sorghum, and small grain. If cultivated crops are grown, further erosion is a hazard. A conservation tillage system that leaves crop residue on the surface, crop rotations that include grasses and legumes, and winter cover crops help to prevent excessive soil loss. Most areas can be terraced and farmed on the contour. Regularly returning crop residue to the soil helps to prevent surface crusting and increases the rate of water infiltration.

This soil is well suited to most of the commonly grown legumes, such as alfalfa and red clover; to cool-season grasses, such as smooth brome and orchardgrass; and to warm-season grasses, such as big bluestem, indiangrass, and switchgrass. No serious problems affect pasture or hayland. Erosion is a hazard in newly seeded areas. Timely seedbed preparation helps to ensure a good ground cover.

This soil is suited to building site development. The shrink-swell potential is a limitation on sites for dwellings. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand and gravel help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excess water in areas where surface drainage is poor and gutters fail.

Septic tank systems function adequately in areas of this soil if perimeter drains are installed around the absorption field to lower the water table. The slope and seepage are limitations on sites for sewage lagoons. The less sloping areas, where less leveling is needed, should be selected as sites for the lagoons. Sealing the lagoons with slowly permeable material helps to prevent the contamination of ground water.

Low strength, the potential for frost action, and the shrink-swell potential are limitations on sites for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate roadside ditches, and installing culverts in low areas improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IIIe.

backfilling with sand and gravel help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excess water in areas where surface drainage is poor and gutters fail.

Septic tank systems function adequately in areas of this soil if perimeter drains are installed around the absorption field to lower the water table. The slope and seepage are limitations on sites for sewage lagoons. The less sloping areas, where less leveling is needed, should be selected as sites for the lagoons. Sealing the lagoons with slowly permeable material helps to prevent the contamination of ground water.

Low strength, the potential for frost action, and the shrink-swell potential are limitations on sites for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate roadside ditches, and installing culverts in low areas improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IIe.

21C2—Wakenda silt loam, 5 to 9 percent slopes, eroded. This deep, moderately sloping, well drained soil is on convex side slopes and narrow ridgetops in the uplands. Erosion has removed some of the original surface layer. Individual areas are irregular in shape and range from about 10 to 195 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 10 inches thick. The subsoil is silty clay loam about 31 inches thick. The upper part is very dark grayish brown and friable; the next part is brown and friable; and the lower part is brown and dark yellowish brown, mottled, and firm. The substratum to a depth of about 60 inches or more is yellowish brown, mottled, friable silt loam. In some areas, grayish brown mottles are within a depth of 36 inches and the subsoil has more clay. In other areas the surface layer is silty clay loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Higginsville soils. These soils are at the head of drainageways and on the lower parts of the side slopes. Also included are some areas of severely eroded soils that have a surface layer that is thinner than that of the Wakenda soil. Included soils make up less than 5 percent of the unit.

Permeability is moderate in the Wakenda soil. Surface runoff is medium in cultivated areas. Natural fertility is high, and organic matter content is moderate. Available water capacity is very high. The seasonal high water table commonly is within a depth of 4 to 6 feet from late fall through spring. The shrink-swell potential is moderate. The surface layer is friable and can be easily tilled throughout a moderately wide range in moisture content. It crusts or puddles, however, after heavy rainfall.

Most areas are used for cultivated crops, but a few areas are used for pasture or hay. This soil is suited to corn, soybeans, grain sorghum, and small grain. If cultivated crops are grown, further erosion is a hazard. A conservation tillage system that leaves crop residue on the surface, crop rotations that include grasses and legumes, and winter cover crops help to prevent excessive soil loss. Most areas can be terraced and farmed on the contour. Regularly returning crop residue to the soil helps to prevent surface crusting and increases the rate of water infiltration.

This soil is well suited to most of the commonly grown legumes, such as alfalfa and red clover; to cool-season grasses, such as smooth brome and orchardgrass; and to warm-season grasses, such as big bluestem, indiangrass, and switchgrass. No serious problems affect pasture or hayland. Erosion is a hazard in newly seeded areas. Timely seedbed preparation helps to ensure a good ground cover.

This soil is suited to building site development. The shrink-swell potential is a limitation on sites for dwellings. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand and gravel help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excess water in areas where surface drainage is poor and gutters fail.

Septic tank systems function adequately in areas of this soil if perimeter drains are installed around the absorption field to lower the water table. The slope and seepage are limitations on sites for sewage lagoons. The less sloping areas, where less leveling is needed, should be selected as sites for the lagoons. Sealing the lagoons with slowly permeable material helps to prevent the contamination of ground water.

Low strength, the potential for frost action, and the shrink-swell potential are limitations on sites for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate roadside ditches, and installing culverts in low areas improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IIIe.

the deep Armster and Greenton soils and rock outcrop. Armster soils are in narrow bands at the upper edge of the mapped areas. Greenton soils are on side slopes at the lower or upper edge of the mapped areas. The rock outcrop occurs in narrow bands low on the slopes. Also included are some areas of severely eroded soils that have a surface layer of brown silty clay loam. Included areas make up about 5 to 10 percent of the unit.

Permeability is very slow in the Gosport soil. Surface runoff is medium. Natural fertility is low, and organic matter content is moderately low. Available water capacity is low. The shrink-swell potential is high. The surface layer is friable but should be tilled only within a narrow range in moisture content. If tilled when wet or dry, it becomes cloddy. Also, it becomes compacted if tilled when wet.

Most areas are used for pasture or hay. Some small areas are cultivated along with the surrounding areas. A few areas are used for woodland.

This soil is well suited to such legumes as lespedeza and birdsfoot trefoil, to such cool-season grasses as tall fescue and orchardgrass, and to such warm-season grasses as big bluestem, Caucasian bluestem, and indiangrass. The rooting depth is moderate, and the droughtiness is a problem during much of the year. Erosion during seedbed preparation is a major concern. Tilling in a timely manner and establishing a ground cover as soon as possible help to prevent excessive soil loss.

This soil is moderately suited to row crops and small grain. If the soil is used as cropland, erosion is a hazard. A conservation tillage system that leaves crop residue on the surface, winter cover crops, crop rotations that include grasses and legumes, and grassed waterways help to prevent excessive soil loss. Most areas can be cultivated on the contour. Because of the moderate depth to bedrock, however, the soil generally is unsuited to terracing. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface compaction, and increases the rate of water infiltration.

A few areas support native hardwoods. This soil is suited to trees. The seedling mortality rate and the hazard of windthrow are the main management concerns. Selecting planting stock that is larger than normal increases the seedling survival rate. The stands in areas of this soil should be thinned less intensively and more frequently than those in areas where windthrow is less likely.

This soil is suited to building site development. The shrink-swell potential is a limitation on sites for dwellings. The moderate depth to bedrock also is a limitation on sites for dwellings with basements, but the bedrock is soft and can be excavated. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand and gravel help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excess water in areas where surface drainage is poor and gutters fail.

This soil generally is unsuitable as a site for septic tank absorption fields and sewage lagoons because of the depth to bedrock, seepage, and the very slow permeability. Sewage lagoons may function adequately if the site is built up with slowly permeable material, which can provide the necessary depth for lagoon construction and minimize the contamination of ground water. The less sloping areas, where less leveling is needed, should be selected as sites for the lagoons. Otherwise, sewage generally can be piped to adjacent areas that are suitable for onsite waste disposal systems.

Low strength, the potential for frost action, and the shrink-swell potential are limitations on sites for local roads and streets. Grading the roads and streets so that they shed water, establishing adequate roadside ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IVe. The woodland ordination symbol is 2C.

25D—Gosport silty clay loam, 9 to 14 percent slopes. This moderately deep, strongly sloping, moderately well drained soil is on convex side slopes along drainageways. Individual areas are irregular in shape and range from about 10 to 500 acres in size.

Typically, the surface layer is dark grayish brown, friable silty clay loam about 5 inches thick. The subsurface layer is brown, friable silty clay loam about 4 inches thick. The subsoil is very firm silty clay about 18 inches thick. The upper part is brown, and the lower part is yellowish brown and mottled. Grayish brown and yellowish brown, soft, weathered shale bedrock is at a depth of about 27 inches. In some areas the depth to bedrock is less than 20 inches or more than 40 inches. In other areas the soil has sand derived from sandstone residuum. In some places the slope is more than 14 percent.

Included with this soil in mapping are small areas of Armster and Greenton soils and rock outcrop. Armster and Greenton soils are deep. Armster soils are in narrow bands at the upper edge of the mapped areas. Greenton soils are on side slopes at the lower or upper edge of the mapped areas. The rock outcrop occurs in

narrow bands low on the slope. Also included are some areas of severely eroded soils that have a surface layer of brown silty clay loam. Included areas make up about 10 to 15 percent of the unit.

Permeability is very slow in the Gosport soil. Surface runoff is rapid. Natural fertility is low, and organic matter content is moderately low. Available water capacity is low. The shrink-swell potential is high. The surface layer is friable but should be tilled only within a narrow range in moisture content. If tilled when wet or dry, it will be cloddy.

Most areas are used for pasture, hay, or woodland. This soil is unsuited to cultivated crops because of the slope and erosion; however, a few small areas are cultivated with the surrounding soils.

This soil is well suited to such legumes as lespedeza and birdsfoot trefoil, to such cool-season grasses as tall fescue and reed canarygrass, and to such warm-season grasses as big bluestem, Caucasian bluestem, and indiangrass. It is moderately suited to most legumes and cool-season grasses. Shallow-rooted species that can tolerate droughtiness should be selected for planting. Erosion during seeding is a serious concern. Tilling in a timely manner and establishing a ground cover as soon as possible help to prevent excessive soil loss.

A few areas support native hardwoods. This soil is suited to trees. The seedling mortality rate and windthrow are management concerns. Selecting planting stock that is larger than normal increases the seedling survival rate. Thinning the stands less intensively and more frequently helps to reduce the hazard of windthrow.

This soil is suited to building site development. The shrink-swell potential and the slope are limitations on sites for dwellings. The moderate depth to bedrock also is a limitation on sites for dwellings with basements, but the bedrock is soft and generally can be excavated. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand or gravel help to prevent the damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excess water in areas where surface drainage is poor and gutters fail. The slope can be overcome by land shaping or by designing the buildings so that they conform to the natural slope of the land.

This soil generally is unsuitable as a site for septic tank absorption fields or for sewage lagoons because of the depth to bedrock, the slope, and the very slow permeability. Sewage lagoons may function adequately if the site is leveled and built up with slowly permeable material, which can provide the necessary depth for lagoon construction and minimize the contamination of ground water.

Low strength, the potential for frost action, the shrink-swell potential, and the slope are limitations on sites for local roads and streets. Grading the roads and streets so that they shed water, establishing roadside ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength. The slope can be overcome by building on the contour.

The land capability classification is VIe. The woodland ordination symbol is 2C.

25F—Gosport silty clay loam, 14 to 30 percent slopes. This moderately deep, moderately steep and steep, moderately well drained soil is on convex side slopes along drainageways in the uplands. Individual areas are irregular in shape and range from about 10 to 1,500 acres in size.

Typically, the surface layer is very dark gray, friable silty clay loam about 4 inches thick. The subsoil is mottled, firm silty clay about 18 inches thick. The upper part is light yellowish brown, the next part is pale brown, and the lower part is light yellowish brown. Light yellowish brown, soft, weathered shale bedrock is at a depth of about 22 inches. In some areas the depth to soft bedrock is less than 20 inches or more than 40 inches. In other areas the soil has sand derived from sandstone residuum. In places the slope is less than 14 percent or more than 30 percent.

Included with this soil in mapping are small areas of rock outcrop. The rock outcrop occurs in narrow bands low on the slopes. It makes up about 5 to 10 percent of the unit.

Permeability is very slow in the Gosport soil. Surface runoff is rapid. Natural fertility is low, and organic matter content is moderately low. Available water capacity is low. The shrink-swell potential is high. The surface layer is friable.

Most areas are used as woodland or pasture. Because of the slope, this soil is unsuited to cultivated crops. This soil is well suited to such legumes as lespedeza and birdsfoot trefoil, to such cool-season grasses as tall fescue and orchardgrass, and to such warm-season grasses as big bluestem and indiangrass. It is moderately suited to such legumes as alfalfa and red clover and to such cool-season grasses as smooth brome. Shallow-rooted species that can tolerate droughtiness should be selected for planting. Erosion during seeding is a serious concern. Tilling in a timely manner and establishing a ground cover as soon as possible help to prevent excessive soil loss. Because of

the slope, the soil is not suited to hay and establishing and maintaining pasture plants is difficult.

This soil is suited to trees. The hazard of erosion, the equipment limitation, the seedling mortality rate, and the hazard of windthrow are management concerns. The design of logging roads and skid trails should minimize the steepness and length of the slopes. In the steepest areas, logs should be yarded uphill to the roads or trails. Small gullies and disturbed areas should be reshaped and seeded after the trees are harvested. Selecting planting stock that is larger than normal increases the seedling survival rate. The stands in areas of this soil should be thinned less intensively and more frequently than those in areas where windthrow is less likely.

This soil generally is not used for building site development or onsite waste disposal systems because of the slope.

The land capability classification is VIIe. The woodland ordination symbol is 2R.

30—Nodaway silt loam. This deep, nearly level, moderately well drained soil is on flood plains or alluvial fans along tributary streams of the Missouri River. It is frequently flooded. Individual areas are long and narrow and range from about 10 to more than 1,000 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 6 inches thick. The substratum to a depth of 60 inches or more is stratified, multicolored, friable silt loam. In some places the lower part of the substratum is black, friable silty clay loam. In other places it is somewhat poorly drained.

Included with this soil in mapping are small areas of the poorly drained Colo and Zook soils. These soils have a higher content of clay than the Nodaway soil. They are in the slightly lower areas between the Nodaway soil and the uplands. Also included are soils that have light colored subsurface layers that are unstratified and poorly drained. These soils are slightly higher on the landscape than the Nodaway soil. Included soils make up about 10 to 15 percent of the unit.

Permeability is moderate in the Nodaway soil. Surface runoff is slow. Natural fertility is high, and organic matter content is moderate. Available water capacity is very high. The seasonal high water table commonly is at a depth of 3 to 5 feet in spring and early summer. The shrink-swell potential is moderate. The surface layer can be easily tilled throughout a wide range in moisture content.

Most areas are used for cultivated crops or pasture. This soil is suited to corn, soybeans, grain sorghum, and small grain, but the short periods of flooding can be a problem (fig. 7). If cultivated crops are grown, the flooding delays tillage in the spring of some years. Fall plowing increases the susceptibility of the soil to scouring by floodwater. Levees help to control the floodwater. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface compaction, and increases the rate of water infiltration.

This soil is suited to such commonly grown legumes as alsike clover, to such cool-season grasses as reed canarygrass and orchardgrass, and to such warm-season grasses as big bluestem and switchgrass. Frequent flooding is the main problem. The species that are tolerant of the wetness grow best on this soil. A properly designed grazing system helps to ensure that pastures are not stocked during periods of flooding.

A few areas support native trees. This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

This soil generally is unsuited to building site development and onsite waste disposal systems because of the frequent flooding.

The land capability classification is IIIw. The woodland ordination symbol is 3A.

32—Colo silty clay loam. This deep, nearly level, poorly drained soil is on flood plains along the tributaries of the Missouri River. It is occasionally flooded. Individual areas are long and narrow and range from about 15 to more than 2,100 acres in size.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 6 inches thick. The subsurface layer is friable silty clay loam about 27 inches thick. The upper part is very dark grayish brown, and the lower part is black and very dark gray. The subsoil to a depth of 60 inches or more is mottled, silty clay loam. The upper part is very dark gray and friable, and the lower part is black and firm. In some areas the subsurface layer has more clay. In other areas the surface layer is silt loam.

Included with this soil in mapping are small areas of the moderately well drained Nodaway soils. These soils have more silt than the Colo soil. They are in areas between the Colo soil and the stream channels. Also included are areas that are lower on the landscape than the Colo soil and frequently flooded. Included soils make up about 5 to 10 percent of the unit.

Permeability is moderate in the Colo soil. Surface runoff is slow. Natural fertility and organic matter content are high. Available water capacity is very high. The seasonal high water table commonly is at a depth of 1 to 3 feet during winter and spring. The shrink-swell

Figure 7.—Flooding in an area of Nodaway silt loam.

potential is moderate. The surface layer is friable but can become compacted and cloddy if it is tilled when wet.

Most areas are used for cultivated crops. A few areas are used for hay and pasture. This soil is suited to corn, soybeans, grain sorghum, and small grain. The flooding is a hazard, but open ditches, shallow surface drains, and land grading can help to remove the excess water quickly. Levees also help to control the floodwater. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to keep the surface layer friable, and increases the rate of water infiltration.

This soil is moderately suited to shallow-rooted legumes, such as alsike clover, that are tolerant of the wetness and to such cool-season grasses as reed canarygrass. It is poorly suited to warm-season grasses. The wetness and the flooding are the main problems. A properly designed grazing system helps to ensure that pastures are not stocked during periods of flooding. A seedbed can be easily prepared only during dry periods. The deeper-rooted species benefit from surface drainage systems.

This soil generally is unsuited to building site development and onsite waste disposal systems because of the occasional flooding.

The land capability classification is IIw.

34—Zook silty clay loam. This deep, nearly level, poorly drained soil is on moderately wide flood plains along tributaries of the Missouri River. It is occasionally flooded. Individual areas are irregular in shape and range from 10 to more than 400 acres in size.

Typically, the surface layer is very dark gray, firm silty clay loam about 8 inches thick. The subsurface layer is black and very dark gray, mottled, firm silty clay

loam and silty clay about 40 inches thick. The subsoil to a depth of 60 inches or more is dark gray, mottled, firm silty clay. In some areas the surface layer is very dark grayish brown silt loam that was recently deposited. In other areas the content of clay in the subsurface layer and subsoil is higher or lower. In places the dark surface layer is thinner.

Included with this soil in mapping are small areas of Bremer and Nodaway soils. Bremer soils have a dark subsurface layer that is thinner than that of the Zook soil. They are between the Zook soil and the stream channels. The moderately well drained Nodaway soils are along the stream channels. Also included in the lower areas are soils that are frequently flooded. Included soils make up about 5 to 10 percent of the unit.

Permeability is slow in the Zook soil. Surface runoff also is slow. Natural fertility and organic matter content are high. Available water capacity also is high. The seasonal high water table commonly is near the surface to a depth of 3 feet during winter and spring. The shrink-swell potential is high. The surface layer is sticky when wet. Careful timing of tillage is needed.

Nearly all of the acreage is used for cultivated crops. Only a few isolated areas are used for hay and pasture. This soil is suited to corn, soybeans, grain sorghum, and small grain. The wetness and the flooding are the main limitations (fig. 8). Crops in depressions may drown. Land grading, shallow surface drains, and open ditches can help to remove excess water. Levees help to control the floodwater. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to keep the surface layer friable, and increases the rate of water infiltration.

This soil is moderately suited to shallow-rooted legumes, such as alsike clover, that are tolerant of the wetness and to such cool-season grasses as reed canarygrass. It is poorly suited to warm-season grasses. The wetness and the flooding are the main problems. A properly designed grazing system helps to ensure that pastures are not stocked during periods of flooding. In depressional areas, maintaining stands of desirable species is difficult. The deeper-rooted species benefit from surface drainage systems.

This soil generally is unsuited to building site development and onsite waste disposal systems because of the occasional flooding.

The land capability classification is IIw.

36—Wabash silty clay. This deep, nearly level, very poorly drained soil is on flood plains along tributaries of the Missouri River. It is occasionally flooded. Individual areas are irregular in shape and range from about 30 to more than 1,300 acres in size.

Typically, the surface layer is very dark gray, firm silty clay about 4 inches thick. The subsurface layer is very dark gray, very firm silty clay about 10 inches thick. The subsoil extends to a depth of more than 60 inches. It is very firm silty clay. The upper part is black, and the lower part is dark grayish brown and mottled. In some areas the dark surface layer is thinner. In other areas the soil has less clay throughout. In a few areas the soil is subject to rare flooding.

Included with this soil in mapping are small areas of the moderately well drained Nodaway soils. These soils are in narrow areas between stream channels and the Wabash soil. Also included are a few areas of Wabash soils that are subject to ponding and some soils that are frequently flooded in the lower areas. Included soils make up about 5 to 10 percent of the unit.

Permeability is very slow in this Wabash soil. Surface runoff is very slow. Natural fertility is medium, and organic matter content is moderate. Available water capacity also is moderate. The seasonal high water table commonly is within a depth of 1 foot during winter and spring. The shrink-swell potential is very high. The surface layer is sticky when wet. If tilled when wet, it becomes cloddy and cannot be easily worked when dry. Careful timing of tillage is needed.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, grain sorghum, and small grain. It warms up slowly in the spring and dries out slowly after rains. The wetness and the flooding are the main limitations. Land grading, shallow surface drains, and open ditches can help to remove excess water. Levees help to control the floodwater. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to keep the surface layer friable, and increases the rate of water infiltration.

This soil generally is unsuited to building site development and onsite waste disposal systems because of the occasional flooding, the very high shrink-swell potential, and the wetness.

The land capability classification is IIIw.

42—Bremer silt loam, occasionally flooded. This deep, nearly level, poorly drained soil is on high flood plains along the smaller streams. It is occasionally flooded. Individual areas generally are long and narrow and range from about 10 to 85 acres in size.

Typically, the surface layer is very dark gray, friable silt loam about 7 inches thick. The subsurface layer is very dark gray, friable silt loam about 8 inches thick. The subsoil extends to a depth of 60 inches or more. It is mottled. The upper part is very dark gray, friable and firm silty clay loam; the next part is dark grayish brown and grayish brown, firm silty clay; and the lower part is gray, firm silty clay loam. In some areas the surface

Figure 8.—Flooding in a pecan grove in an area of Zook silty clay loam along Big Creek.

layer was recently deposited and is very dark grayish brown. In other areas it is silty clay loam. In some places the dark upper part of the soil is less than 24 inches thick. In other places the subsoil has free carbonates. In some areas the dark grayish brown subsurface layer and the subsoil have less clay.

Included with this soil in mapping are small areas of Nodaway and Zook soils. Nodaway soils are moderately well drained and are closer to the stream channels than the Bremer soil. Zook soils have a dark surface layer and a subsurface layer that are thicker than those of the Bremer soil. They are in the slightly lower areas next to the uplands. Included soils make up about 5 to 10 percent of the unit.

Permeability is moderately slow in the Bremer soil. Surface runoff is slow. Natural fertility and organic matter content are high. Available water capacity also is high. The seasonal high water table commonly is at a depth of 1 to 2 feet during winter and spring. The shrink-swell potential is high. The surface layer is

friable. It becomes cloddy, however, if tilled when wet. Also, it crusts or puddles, especially after heavy rainfall.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, grain sorghum, and small grain. The wetness and the flooding are the main limitations. Land grading, shallow surface drains, and open ditches can help to remove excess water. Levees help to control the floodwater. Diversion terraces may be needed to intercept the runoff from the uplands. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to keep the surface layer friable, and increases the rate of water infiltration.

This soil is moderately suited to shallow-rooted legumes, such as ladino clover and alsike clover, that are tolerant of the wetness and to such cool-season grasses as reed canarygrass. It is poorly suited to warm-season grasses. The wetness and the flooding are the main problems. A properly designed grazing system helps to ensure that pastures are not stocked during periods of flooding. In depressional areas, maintaining stands of desirable species is difficult.

This soil is suited to trees. The equipment limitation, the seedling mortality rate, and the hazard of windthrow are the main management concerns. Equipment should be operated only when the soil is dry or frozen. Selecting planting stock that is larger than normal and planting on prepared ridges increase the seedling survival rate. The stands in areas of this soil should be thinned less intensively and more frequently than those in areas where windthrow is less likely.

This soil generally is unsuited to building site development and onsite waste disposal systems because of the occasional flooding.

The land capability classification is IIw. The woodland ordination symbol is 7W.

60—Aholt silty clay. This deep, nearly level, very poorly drained soil is in broad areas on flood plains along the Missouri River. It is protected by levees but is occasionally flooded as a result of levee breaks or as a result of overflow from local tributaries. Individual areas are irregular in shape and are about 800 acres in size.

Typically, the surface layer is black, firm silty clay about 6 inches thick. The subsoil is mottled, very firm silty clay and clay about 41 inches thick. The upper part is black and very dark gray, and the lower part is dark gray. The substratum to a depth of 60 inches or more is dark gray, mottled, firm silty clay loam. In a few areas the surface layer has more clay. In some areas the subsoil is underlain with loamy material below a depth of 36 inches.

Included with this soil in mapping are a few areas of Aholt soils that are lower on the landscape and are ponded for significant periods. Also included are a few small areas of Norborne and Bremer soils in the slightly higher landscape positions. Norborne soils are well drained and are more sandy than the Aholt soil. Bremer soils are poorly drained and have less clay than the Aholt soil. Included soils make up about 5 to 10 percent of the unit.

Permeability is very slow in this Aholt soil. Surface runoff also is very slow. Natural fertility is medium, and organic matter content is moderate. Available water capacity also is moderate. The seasonal high water table commonly is within a depth of 1 foot during winter and spring. The shrink-swell potential is very high. The surface layer has a high content of clay and can be tilled only within a very narrow range in moisture content. It puddles and crusts after heavy rainfall. Root development is restricted by poor aeration.

Nearly all of the acreage is used for cultivated crops. This soil is suited to soybeans, corn, and small grain. The wetness results in lower yields in some years. This limitation can be overcome by land grading, shallow surface drains, and open ditches. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration. Fall tillage improves tilth for the crops grown the following spring.

This soil is suited to trees. The equipment limitation, the seedling mortality rate, and the hazard of windthrow are the main management concerns. Equipment should be operated only when the soil is dry or frozen. Selecting planting stock that is larger than normal increases the seedling survival rate. The stands in areas of this soil should be thinned less intensively and more frequently than those in areas where windthrow is less likely.

This soil generally is unsuited to building site development and onsite waste disposal systems because of the occasional flooding, the very high shrink-swell potential, and the wetness.

The land capability classification is IIIw. The woodland ordination symbol is 7W.

62—Booker silty clay. This deep, nearly level, very poorly drained soil is in broad areas on flood plains along the Missouri River. It is protected by levees but is occasionally flooded as a result of levee breaks or as a result of overflow from local tributaries. It commonly is ponded after heavy rains. Individual areas are irregular in shape and range from about 100 to 3,000 acres in size.

Typically, the surface layer is black, very firm silty clay about 5 inches thick. The subsoil extends to a depth of 60 inches or more. It is very firm clay. The

upper part is black and about 7 inches thick, and the lower part is very dark gray and gray and is mottled. In some areas the surface layer is clay. In other areas the subsoil is underlain with loamy, calcareous material below a depth of 36 inches.

Included with this soil in mapping are small areas of Norborne and Bremer soils. The well drained Norborne soils are on natural levees. The poorly drained Bremer soils have less clay than the Booker soil and are slightly higher on the landscape. Included soils make up about 5 to 10 percent of the unit.

Permeability is very slow in the Booker soil. Surface runoff is very slow or ponded. Natural fertility is medium, and organic matter content is moderate. Available water capacity also is moderate. The seasonal high water table commonly is 0.5 foot above the surface to 1.0 foot below during winter and spring. The shrink-swell potential is very high. The surface layer has a high content of clay and can be tilled only within a very narrow range in moisture content. It puddles and crusts after heavy rainfall. Root development is restricted by poor aeration.

Nearly all of the acreage is used for cultivated crops. This soil is suited to soybeans, corn, and small grain. It is best suited to the row crops that require a short growing season. The wetness results in lower yields in some years. Measures that intercept the runoff from adjacent hillsides, land grading, shallow surface drains, and open ditches help to remove the excess water. Returning crop residue to the soil or regularly adding other organic material helps to prevent surface crusting, improves fertility, and increases the rate of water infiltration. Fall tillage improves tilth for the crops grown the following spring.

This soil is suited to trees. The equipment limitation, the seedling mortality rate, and the hazard of windthrow are the main management concerns. Equipment should be operated only when the soil is dry or frozen. Selecting planting stock that is larger than normal and planting on prepared ridges increase the seedling survival rate. The stands in areas of this soil should be thinned less intensively and more frequently than those in areas where windthrow is less likely.

This soil generally is unsuited to building site development and onsite waste disposal systems because of the occasional flooding, the very high shrink-swell potential, and the very slow permeability.

The land capability classification is IIIw. The woodland ordination symbol is 6W.

64—Cotter silt loam. This deep, nearly level, well drained soil is on high flood plains along the Missouri River. It is protected by levees but is subject to rare flooding as a result of levee breaks. Individual areas are irregular in shape and range from about 10 to more than 1,200 acres in size.

Typically, the surface layer is black, friable silt loam about 8 inches thick. The subsurface layer also is black, friable silt loam. It is about 6 inches thick. The subsoil extends to a depth of 60 inches or more. It is friable. The upper part is black and dark brown silty clay loam, and the lower part is brown silt loam. In some areas the slope is more than 2 percent. In other areas the subsoil is mottled.

Included with this soil in mapping are small areas of Norborne and Bremer soils. Norborne soils have more sand than the Cotter soil and are slightly higher on the landscape. Bremer soils have more clay than the Cotter soil and are lower on the landscape. Included soils make up about 5 to 10 percent of the unit.

Permeability is moderate in the Cotter soil. Surface runoff is slow. Natural fertility is high, and organic matter content is moderate. Available water capacity is very high. The shrink-swell potential is moderate in the subsoil. The surface layer is friable and can be easily tilled throughout a wide range in moisture content. It tends to crust or puddle, however, after heavy rainfall.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, grain sorghum, and small grain. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

This soil is well suited to most of the commonly grown legumes, such as alfalfa and red clover; to cool-season grasses, such as bromegrass and orchardgrass; and to warm-season grasses, such as big bluestem and switchgrass. No serious problems affect pasture or hayland.

This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

This soil is suited to building site development if levees protect the site from flooding or if the buildings are constructed on raised, well compacted fill material above the known flood level. The shrink-swell potential is a limitation on sites for dwellings. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand and gravel help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excess water in areas where surface drainage is poor and gutters fail.

This soil is suited to onsite waste disposal systems if it is protected from the flooding. The moderate permeability is a limitation affecting septic tank absorption fields. It can be overcome, however, by enlarging the absorption field. Seepage is a limitation

on sites for sewage lagoons. Sealing the lagoons with slowly permeable material helps to prevent the contamination of ground water.

The flooding, low strength, the potential for frost action, and the shrink-swell potential are limitations on sites for local roads and streets. The roads and streets should be protected by levees and constructed on raised, well compacted fill material above the known flood level. Grading the roads and streets so that they shed water, establishing adequate roadside ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is I. The woodland ordination symbol is 9A.

66—Gilliam silt loam. This deep, nearly level, somewhat poorly drained soil is on flood plains along the Missouri River. It is protected by levees but is occasionally flooded as a result of levee breaks or as a result of overflow from local tributaries. Individual areas are irregular in shape and range from about 15 to 560 acres in size.

Typically, the surface layer is very dark grayish brown, friable silt loam about 6 inches thick. The subsurface layer is friable. The upper part is very dark grayish brown silt loam about 10 inches thick. The next part is very dark gray silty clay loam. The substratum to a depth of 54 inches is dark grayish brown, stratified, friable silt loam. Below this to a depth of 60 inches or more is a buried surface layer that is very dark grayish brown, mottled, firm silty clay loam. In some areas the surface layer is very fine sandy loam or silty clay loam. In other areas the substratum has thin strata of silty clay, fine sandy loam, or loamy fine sand.

Included with this soil in mapping are small areas of Leta and Waldron soils. Leta soils are clayey in the upper part. Waldron soils have more clay throughout than the Gilliam soil. Waldron and Leta soils are lower on the landscape than the Gilliam soil. Also included are areas of Gilliam soils that are between the levees and the Missouri River and are frequently flooded. Included soils make up about 5 to 10 percent of the unit.

Permeability is moderate in this Gilliam soil. Surface runoff is slow. Natural fertility is high, and organic matter content is moderate. Available water capacity is very high. The seasonal high water table commonly is at a depth of 1.5 to 3.0 feet during winter and spring. The shrink-swell potential is moderate. The surface layer is friable and can be easily tilled.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, grain sorghum, and winter wheat. The wetness is the main limitation. This limitation can be overcome by land grading, shallow surface drains, and open ditches. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

This soil generally is unsuited to building site development and onsite waste disposal systems because of the occasional flooding. The history of flooding in a given area should be considered when selecting sites for buildings and sanitary facilities.

The land capability classification is IIw. The woodland ordination symbol is 8A.

68—Haynie very fine sandy loam. This deep, nearly level, moderately well drained soil is in the slightly higher areas on flood plains along the Missouri River. It is protected by levees but is occasionally flooded as a result of levee breaks or as a result of overflow from local tributaries. Individual areas generally are long and narrow and range from about 10 to more than 800 acres in size.

Typically, the surface layer is very dark grayish brown, very friable very fine sandy loam about 9 inches thick. The upper part of the substratum is dark grayish brown, very friable very fine sandy loam that has strata of silt loam and fine sandy loam. The lower part to a depth of 60 inches or more is dark grayish brown, mottled, friable silt loam that has thin strata of silty clay loam. In some areas the surface layer is silt loam or silty clay loam. In other areas the substratum has more sand.

Included with this soil in mapping are small areas of Gilliam, Landes, Leta, and Waldron soils. Gilliam soils have less sand than the Haynie soil and are slightly lower on the landscape. Landes soils have more sand than the Haynie soil and are in the slightly higher areas. Leta and Waldron soils are somewhat poorly drained and are clayey in the upper part. They are in small drainageways and depressions. Also included are areas of Haynie soils that are between the levees and the Missouri River and are frequently flooded. Included soils make up about 5 to 10 percent of the unit.

Permeability is moderate in this Haynie soil. Surface runoff is slow. Natural fertility is high, and organic matter content is moderately low. Available water capacity is very high. The seasonal high water table commonly is at a depth of 3 to 6 feet during most winter and spring months. The surface layer is very friable and can be easily tilled throughout a wide range in moisture content.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, grain sorghum, and small grain. Returning crop residue to the soil or regularly adding other organic material improves fertility and tilth and increases the rate of water infiltration.

This soil is well suited to most of the commonly grown legumes, such as alfalfa and red clover; to cool-season grasses, such as timothy and orchardgrass; and to warm-season grasses, such as big bluestem and switchgrass. A properly designed grazing system helps to ensure that the pastures are not stocked during periods of flooding.

This soil is suited to trees. No major hazards or limitations affect harvesting.

This soil generally is unsuited to building site development and onsite waste disposal systems because of the occasional flooding. The history of flooding in a given area should be considered when selecting sites for buildings and sanitary facilities.

The land capability classification is IIw. The woodland ordination symbol is 11A.

70—Hodge loamy fine sand. This deep, nearly level, somewhat excessively drained soil is in the slightly higher areas on flood plains along the Missouri River. It is protected by levees but is occasionally flooded as a result of levee breaks. Individual areas are long and narrow and range from about 10 to more than 100 acres in size.

Typically, the surface layer is dark brown, loose loamy fine sand about 6 inches thick. The substratum extends to a depth of 60 inches or more. It is dark grayish brown, loose fine sand in the upper part; dark grayish brown, very friable loamy fine sand in the next part; and dark grayish brown and brown, loose loamy fine sand in the lower part. In some areas the substratum has finer textured strata.

Included with this soil in mapping are small areas of the moderately well drained Haynie and Kenmoor soils. These soils are slightly lower on the landscape than the Hodge soil. Haynie soils have less sand than the Hodge soil. Kenmoor soils have a clayey substratum. Also included are areas of Hodge soils that are between the levees and the Missouri River and are frequently flooded. Included soils make up about 5 to 10 percent of the unit.

Permeability is rapid in this Hodge soil. Surface runoff is slow. Natural fertility and organic matter content are low. Available water capacity also is low. The surface layer is loose and can be easily tilled throughout a wide range in moisture content.

Most areas are used for cultivated crops. This soil is poorly suited to cultivated crops because soil moisture is commonly insufficient during the hot summer months. If cultivated crops are grown, irrigation is needed. Unless the soil is protected, wind erosion is a hazard. It damages young crops. Cover crops, wind stripcropping, and field windbreaks help to control erosion. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to prevent excessive wind erosion.

This soil is suited to most of the commonly grown legumes, such as alfalfa and red clover; to cool-season grasses, such as orchardgrass and tall fescue; and to warm-season grasses, such as big bluestem and indiangrass. Droughtiness is the main management concern.

This soil is suited to trees. The seedling mortality rate is the main management concern. Selecting planting stock that is larger than normal increases the seedling survival rate.

This soil generally is unsuited to building site development and onsite waste disposal systems because of the occasional flooding. The history of flooding in a given area should be considered when selecting sites for buildings and sanitary facilities.

The land capability classification is IIIs. The woodland ordination symbol is 11S.

72—Kenmoor loamy fine sand. This deep, nearly level, moderately well drained soil is on flood plains along the Missouri River. It is protected by levees but is occasionally flooded as a result of levee breaks. Individual areas are irregular in shape and range from about 10 to more than 100 acres in size.

Typically, the surface layer is dark grayish brown, very friable loamy fine sand about 6 inches thick. The upper part of the substratum is grayish brown, loose loamy fine sand and fine sand about 22 inches thick. The next part is very dark grayish brown, firm silty clay. The lower part to a depth of 60 inches or more is grayish brown, firm silty clay. In some areas the sandy upper part contains less sand or is thinner.

Included with this soil in mapping are some areas of the somewhat excessively drained Hodge soils. These soils do not have a clayey substratum and are in the slightly higher areas. They make up about 5 percent of the unit.

Permeability in the Kenmoor soil is rapid in the sandy upper part and slow in the clayey lower part. Surface runoff is slow. Natural fertility and organic matter content are low. Available water capacity is moderate. The seasonal high water table commonly is at a depth of 2.5 to 3.0 feet during winter and spring. The shrink-swell potential is low in the sandy upper part and high in the clayey lower part. The surface layer is very friable and can be easily tilled throughout a wide range in moisture content.

Most areas are used for cultivated crops. This soil is poorly suited to cultivated crops because soil moisture is commonly insufficient during the hot summer months. If cultivated crops are grown, irrigation is needed. Unless the soil is protected, wind erosion is a hazard. It damages young crops. Cover crops, wind stripcropping, and field windbreaks help to control erosion. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to prevent excessive wind erosion.

This soil is suited to most of the commonly grown legumes, such as alfalfa and red clover; to cool-season grasses, such as orchardgrass and tall fescue; and to warm-season grasses, such as big bluestem and indiangrass. Droughtiness is the main management concern.

This soil is suited to trees. The seedling mortality rate is the main management concern. Selecting planting stock that is larger than normal increases the seedling survival rate.

This soil generally is unsuited to building site development and onsite waste disposal systems because of the occasional flooding. The history of flooding in a given area should be considered when selecting sites for buildings and sanitary facilities.

The land capability classification is IIIs. The woodland ordination symbol is 6S.

74—Landes fine sandy loam. This deep, nearly level, well drained soil is in the slightly higher areas on flood plains along the Missouri River. It is protected by levees but is occasionally flooded as a result of levee breaks or as a result of overflow from local tributaries. Individual areas are irregular in shape and range from about 10 to more than 190 acres in size.

Typically, the surface layer is very dark grayish brown, very friable fine sandy loam about 7 inches thick. The subsurface layer is very dark grayish brown, friable fine sandy loam about 13 inches thick. The subsoil is brown, friable loamy fine sand about 13 inches thick. The substratum to a depth of 60 inches or more is brown and dark yellowish brown and is mottled. The upper part is very friable loamy fine sand, and the lower part is loose fine sand. In some areas, the content of sand is higher and the dark surface layer is thinner.

Included with this soil in mapping are small areas of Haynie, Norborne, and Waldron soils. Haynie soils are moderately well drained and have less sand than the Landes soil. They are in landscape positions that are similar to those of the Landes soil. Norborne soils have a dark surface layer that is thicker than that of the Landes soil and are slightly higher on the landscape. Waldron soils are somewhat poorly drained and have more clay than the Landes soil. They are lower on the landscape than the Landes soil. Included soils make up about 5 to 10 percent of the unit.

Permeability is rapid in the Landes soil. Surface runoff is slow. Natural fertility is medium, and organic matter content is moderately low. Available water capacity is moderate. The seasonal high water table commonly is at a depth of 4 to 6 feet during winter and spring. The surface layer is friable and can be easily tilled throughout a wide range in moisture content.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, and small grain. Returning crop residue to the soil or regularly adding other organic material increases the available water capacity, improves fertility, and helps to prevent surface crusting.

This soil is well suited to most of the commonly grown legumes, such as alfalfa and red clover; to cool-season grasses, such as tall fescue and reed canarygrass; and to warm-season grasses, such as big bluestem and switchgrass.

This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

This soil generally is unsuited to building site development and onsite waste disposal systems because of the occasional flooding. The history of flooding in a given area should be considered when selecting sites for buildings and sanitary facilities.

The land capability classification is IIw. The woodland ordination symbol is 10A.

76—Leta silty clay. This deep, nearly level, somewhat poorly drained soil is on flood plains along the Missouri River. It is protected by levees but is occasionally flooded as a result of levee breaks or as a result of overflow from local tributaries. Individual areas are irregular in shape and range from about 10 to more than 1,000 acres in size.

Typically, the surface layer is very dark gray, firm silty clay about 5 inches thick. The subsurface layer also is very dark gray, firm silty clay. It is about 7 inches thick. The subsoil is about 13 inches thick. It is very dark grayish brown, mottled, firm silty clay that has strata of dark grayish brown silt loam. The substratum extends to a depth of 60 inches or more. The upper part is stratified dark grayish brown and very dark grayish brown, mottled, very friable very fine sandy loam, and the lower part is stratified dark grayish brown and brown, mottled, friable silt loam and very fine sandy loam. In a few places the silty clay in the upper part of the soil is less than 20 inches thick. In other places the substratum has more sand. In areas along the Grand River, the Leta soil does not have free carbonates. In other areas it is poorly drained.

Included with this soil in mapping are small areas of

the moderately well drained Haynie soils. These soils have less clay than the Leta soil and are slightly higher on the landscape. They make up about 5 to 10 percent of the unit.

Permeability is slow in the clayey upper part of the Leta soil and moderate in the loamy lower part. Surface runoff generally is slow. Natural fertility is high, and organic matter content is moderate. Available water capacity also is moderate. The seasonal high water table commonly is at a depth of 1 to 3 feet during winter and spring. The shrink-swell potential is high in the surface soil and subsoil and low in the substratum. The surface layer is very firm when dry and sticky when wet. It becomes cloddy if tilled when wet or dry. Careful timing of tillage is needed.

Most areas are used for cultivated crops. This soil is suited to soybeans, grain sorghum, corn, and winter wheat. Surface runoff is slow. The surface is covered by water after heavy rainfall or by runoff from adjacent areas. Land grading, shallow surface drains, and open ditches help to remove the excess surface water. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

This soil is suited to trees. The equipment limitation, the seedling mortality rate, and the hazard of windthrow are the main management concerns. Equipment should be operated only when the soil is dry or frozen. Selecting planting stock that is larger than normal and planting on prepared ridges increase the seedling survival rate. The stands should be thinned less intensively and more frequently to reduce the hazard of windthrow.

This soil generally is unsuited to building site development and onsite waste disposal systems because of the wetness and the occasional flooding. The history of flooding in a given area should be considered when selecting sites for buildings and sanitary facilities.

The land capability classification is IIw. The woodland ordination symbol is 7W.

84—Norborne loam. This deep, nearly level, well drained soil is in the slightly higher areas on flood plains along the Missouri River. It is protected by levees but is subject to rare flooding as a result of levee breaks. Individual areas are long and moderately wide and range from about 10 to more than 190 acres in size.

Typically, the surface layer is black, friable loam about 5 inches thick. The subsurface layer also is black, friable loam. It is about 9 inches thick. The subsoil is about 39 inches thick. The upper part is very dark grayish brown, friable loam; the next part is brown, friable loam; and the lower part is brown, very friable very fine sandy loam. The substratum to a depth of 60 inches or more is brown, loose fine sandy loam. In some areas the dark surface layer is thinner. In other areas the slope is more than 2 percent.

Included with this soil in mapping are small areas of Cotter, Hodge, Leta, and Bremer soils. Cotter soils have a silty subsoil and are slightly lower on the landscape than the Norborne soil. Hodge soils have more sand than the Norborne soil and are slightly higher on the landscape. Leta soils have a clayey surface layer and are in narrow drainageways. Bremer soils are somewhat poorly drained and are slightly lower on the landscape than the Norborne soil. Included soils make up about 10 to 15 percent of the unit.

Permeability is moderate in the Norborne soil. Surface runoff is slow. Natural fertility is high, and organic matter content is moderate. Available water capacity is high. The surface layer is friable and can be easily tilled throughout a wide range in moisture content.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, small grain, and grain sorghum. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

This soil is well suited to most of the commonly grown legumes, such as alfalfa and red clover; to cool-season grasses, such as smooth brome and orchardgrass; and to warm-season grasses, such as big bluestem, indiangrass, and switchgrass. No serious problems affect pasture or hayland.

This soil is suited to trees. No major hazards or limitations affect planting or harvesting.

This soil is suited to building site development. Levees are needed to protect the site from flooding, or the buildings need to be constructed on raised, well compacted fill material above the known flood level.

This soil is suited to onsite waste disposal systems if it is protected from the flooding. The moderate permeability is a limitation affecting septic tank absorption fields. It can be overcome, however, by enlarging the absorption field. Seepage is a limitation on sites for sewage lagoons. Sealing the lagoons with slowly permeable material helps to prevent the contamination of ground water.

The flooding, low strength, and the potential for frost action are limitations on sites for local roads and streets. The roads and streets should be protected by levees and constructed on raised, well compacted fill material above the known flood level. Grading the roads and streets so that they shed water, establishing

adequate roadside ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is I. The woodland ordination symbol is 5A.

86—Parkville silty clay loam. This deep, nearly level, somewhat poorly drained soil is on flood plains along the Missouri River. It is protected by levees but is occasionally flooded as a result of levee breaks or as a result of overflow from local tributaries. Areas are irregular in shape and range from about 10 to more than 700 acres in size.

Typically, the surface layer is very dark grayish brown and very dark gray, firm silty clay loam about 10 inches thick. The subsurface layer is very dark grayish brown, firm silty clay about 7 inches thick. The substratum to a depth of 60 inches or more is stratified, multicolored, very friable very fine sandy loam and silt loam. In some areas the clayey upper part of the soil is more than 20 inches thick. In other areas the surface layer is silty clay.

Included with this soil in mapping are small areas of the moderately well drained Haynie soils. These soils have less clay throughout than the Parkville soil and are in the slightly higher, narrow areas. They make up less than 5 percent of the unit.

Permeability is very slow in the upper part of the Parkville soil and moderate in the lower part. Surface runoff is slow. Natural fertility is medium, and organic matter content is moderate. Available water capacity is high. The seasonal high water table commonly is at a depth of 1 to 2 feet during winter and spring. The shrink-swell potential is high in the clayey upper part of the soil and low in the loamy lower part. The surface layer is firm and becomes cloddy if tilled when wet. Careful timing of tillage is needed.

Most areas are used for cultivated crops. This soil is suited to soybeans, grain sorghum, corn, and winter wheat. The wetness is the main limitation. Land grading, shallow surface drains, and open ditches help to remove the excess water. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

This soil is suited to trees. The equipment limitation and the seedling mortality rate are the main management concerns. Equipment should be operated only when the soil is dry or frozen. Selecting planting stock that is larger than normal and planting on prepared ridges increase the seedling survival rate.

This soil generally is unsuited to building site development and onsite waste disposal systems because of the wetness and the occasional flooding. The history of flooding in a given area should be considered when selecting sites for buildings and sanitary facilities.

The land capability classification is IIw. The woodland ordination symbol is 9C.

88—Bremer silty clay loam, rarely flooded. This deep, nearly level, poorly drained soil is on flood plains along the Missouri River. It is protected by levees but is subject to rare flooding as a result of levee breaks or as a result of overflow from local tributaries. Individual areas are irregular in shape and range from about 15 to more than 8,500 acres in size.

Typically, the surface layer is black, firm silty clay loam about 12 inches thick. The subsoil extends to a depth of 60 inches or more. The upper part is very dark gray, mottled, very firm silty clay; the next part is dark grayish brown, mottled, very firm silty clay; and the lower part is grayish brown, mottled, firm silty clay loam. In some areas the surface layer is silt loam. In other areas the dark upper part of the soil is more than 24 inches thick.

Included with this soil in mapping are small areas of Cotter and Leta soils. Cotter soils are well drained and are in the slightly higher areas. Leta soils are clayey in the upper part and loamy in the lower part. They are in narrow depressions. Included soils make up about 5 to 10 percent of the unit.

Permeability is moderately slow in the Bremer soil. Surface runoff is slow. Natural fertility and organic matter content are high. Available water capacity also is high. The seasonal high water table commonly is at a depth of 1 to 2 feet during winter and spring. The shrink-swell potential is high. The surface layer is firm. It becomes cloddy if tilled when wet. Also, it crusts or puddles, especially after heavy rainfall.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, grain sorghum, and small grain. Land grading, shallow surface drains, and open ditches help to remove the excess water. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

This soil is suited to trees. The equipment limitation, the seedling mortality rate, and the hazard of windthrow are the main management concerns. Equipment should be operated only when the soil is dry or frozen. Selecting planting stock that is larger than normal and planting on prepared ridges increase the seedling survival rate. The stands in areas of this soil should be thinned less intensively and more frequently than those in areas where windthrow is less likely.

This soil is suited to building site development if levees protect the site from flooding or if the buildings are constructed on raised, well compacted fill material above the known flood level. The shrink-swell potential is a limitation on sites for dwellings. Constructing footings, foundations, and basement walls with adequately reinforced concrete and backfilling with sand and gravel help to prevent the structural damage caused by shrinking and swelling. Installing drainage tile at the base of the sand and gravel helps to prevent the damage caused by excessive wetness around the foundations and basement walls and helps to keep basements dry.

This soil is unsuitable as a site for septic tank absorption fields because of the wetness and the moderately slow permeability. Seepage and flooding are limitations on sites for lagoons. Sealing the lagoons with slowly permeable material helps to prevent seepage. The history of flooding in a given area should be considered when selecting sites for buildings and sanitary facilities.

The flooding, low strength, the potential for frost action, and the shrink-swell potential are limitations on sites for local roads and streets. The roads and streets should be protected by levees and constructed on raised, well compacted fill material above the known flood level. Grading the roads and streets so that they shed water, establishing adequate roadside ditches, and installing culverts improve drainage and thus help to prevent the damage caused by frost action and by shrinking and swelling. Adding crushed rock or other suitable base material helps to prevent the damage caused by low strength.

The land capability classification is IIw. The woodland ordination symbol is 7W.

90—Waldron silty clay loam. This deep, nearly level, somewhat poorly drained soil is on flood plains along the Missouri River. It is protected by levees but is occasionally flooded as a result of levee breaks or as a result of overflow from local tributaries. Individual areas are irregular in shape and range from about 10 to more than 1,600 acres in size.

Typically, the surface layer is very dark grayish brown, friable silty clay loam about 8 inches thick. The substratum to a depth of 60 inches or more is firm and mottled. The upper part is very dark gray silty clay, the next part is very dark grayish brown silty clay that has strata of dark gray and dark grayish brown very fine sandy loam, and the lower part is very dark grayish brown silty clay loam that has strata of brown and dark grayish brown very fine sandy loam. In some areas the soil has less clay throughout. In other areas the surface layer is silty clay. In some places the soil is poorly drained.

Included with this soil in mapping are small areas of Haynie and Leta soils. Haynie soils are loamy throughout. Leta soils are clayey in the upper part and loamy in the lower part. Haynie and Leta soils are in the slightly higher areas. Also included are areas of Waldron soils that are between the levees and the Missouri River and are frequently flooded. Included soils make up about 5 to 10 percent of the unit.

Permeability is slow in this Waldron soil. Surface runoff also is slow. Natural fertility is medium, and organic matter content is moderate. Available water capacity also is moderate. The seasonal high water table commonly is at a depth of 1 to 3 feet during winter and spring. The shrink-swell potential is high. The surface layer is friable. It becomes cloddy, however, if tilled when wet or dry. Careful timing of tillage is needed.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, and small grain. The wetness is the main limitation. This limitation can be overcome by open ditches, shallow surface drains, and land grading. Returning crop residue to the soil or regularly adding other organic material improves fertility and tilth, helps to prevent surface crusting, and increases the rate of water infiltration.

This soil is suited to trees. The equipment limitation and the seedling mortality rate are the main management concerns. Equipment should be operated only when the soil is dry or frozen. Selecting planting stock that is larger than normal and planting on prepared ridges increase the seedling survival rate.

This soil generally is unsuited to building site development and onsite waste disposal systems because of the wetness and the occasional flooding. The history of flooding in a given area should be considered when selecting sites for buildings and sanitary facilities.

The land capability classification is IIw. The woodland ordination symbol is 11C.

92—Waubonsie fine sandy loam, loamy substratum. This deep, nearly level, somewhat poorly drained soil is on flood plains along the Missouri River. It is protected by levees but is occasionally flooded as a result of levee breaks. Individual areas are irregular in shape and range from about 10 to more than 250 acres in size.

Typically, the surface layer is very dark grayish brown, very friable fine sandy loam about 7 inches thick. The substratum is about 13 inches thick. It is dark grayish brown, mottled, very friable fine sandy loam that

has thin strata of very fine sandy loam and silt loam. Below this to a depth of 60 inches or more is very dark grayish brown, mottled, friable silty clay loam; very dark gray and dark grayish brown, mottled, firm silty clay; and multicolored, stratified, friable silty clay loam, silt loam, and very fine sandy loam. In some areas the loamy upper part has more sand or less sand or is thinner.

Included with this soil in mapping are small areas of Haynie and Waldron soils. Haynie soils do not have a thick clayey layer. They are in the slightly higher areas. Waldron soils are clayey throughout and are in the lower areas. Included soils make up about 5 to 10 percent of the unit.

Permeability is moderately rapid in the upper part of the Waubonsie soil and slow in the lower part. Surface runoff is slow. Natural fertility is medium, and organic matter content is moderately low. Available water capacity is moderate. The seasonal high water table commonly is at a depth of 2 to 4 feet during winter and spring. The shrink-swell potential is low in the sandy upper part of the soil and high in the clayey lower part. The surface layer is very friable and can be easily tilled throughout a wide range in moisture content.

Most areas are used for cultivated crops. This soil is suited to corn, soybeans, grain sorghum, and winter wheat. Unless the soil is protected, wind erosion is a hazard. It damages young crops. Cover crops, wind stripcropping, and field windbreaks help to control wind erosion. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to prevent excessive wind erosion.

This soil generally is unsuited to building site development and onsite waste disposal systems because of the occasional flooding. The history of flooding in a given area should be considered when selecting sites for buildings and sanitary facilities.

The land capability classification is IIs.

100—Udorthents, nearly level to strongly sloping. These manmade soils are in the uplands and mainly consist of landfills constructed to dispose of refuse. The landfills are made up of several feet of refuse that was placed in trenches and covered with a layer of soil. Individual areas range from about 15 to more than 40 acres in size.

Typically, the landfill cover is a mixture of soil material about 20 to 40 inches thick. Texture at any given depth varies greatly. It is silt loam, silty clay loam, clay loam, or silty clay and most commonly is silty clay loam.

Included with these soils in mapping are areas that have cover material less than 20 inches thick and filled areas that are not underlain with refuse. Included areas make up about 5 to 10 percent of the unit.

Permeability is moderately slow or slow. Organic matter content generally is low. The estimated available water capacity is moderate. Acidity, drainage, natural fertility, and runoff are variable.

Most areas have a fair or good cover of grasses and legumes. Most areas also are idle, but some are used for grazing.

No land capability classification is assigned.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban or built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal expenditure of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

About 130,095 acres in Carroll County, or about 29 percent of the total acreage, meets the requirements for prime farmland. An additional 112,580 acres meets the requirements only if the soil is drained or protected against flooding. Scattered areas of this land are throughout the county, but most are in the southern part, mainly in associations 5 and 6, which are described under the heading "General Soil Map Units."

The map units in the survey area that are considered

prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Some soils that have a seasonal high water table and all soils that are frequently flooded during the growing season qualify as prime farmland only in areas where these limitations have been overcome by drainage measures or flood control. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not these limitations have been overcome by corrective measures.

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help to prevent soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreational facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help to prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

Jens Jensen, district conservationist, Soil Conservation Service, helped prepare this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the county, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under the heading "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

Crops are grown on about 251,000 acres in Carroll County. In 1984, about 45,000 acres was used for wheat, 40,000 acres for corn, 143,500 acres for soybeans, and 14,000 acres for grain sorghum. About 77,000 acres is used for hay and pasture *(3)*.

The acreage used for crops is gradually increasing as pasture is converted to cropland. The main concerns in managing the cropland and pasture are erosion, fertility, tilth, and drainage.

Water erosion is the major hazard on about 61 percent of the cropland and pasture in Carroll County, especially where the slope is more than 2 percent. Two forms of this erosion are sheet erosion and gully erosion. Sheet erosion is more damaging to crops than gully erosion. The loss of the surface layer through erosion results in lower fertility, lower available water capacity, lower productivity, poorer tilth, a decreased infiltration rate, and higher energy requirements for tillage. Erosional sediments pollute lakes, ponds, and streams and fill roadside ditches and drainage systems. Erosion control is needed to reduce the pollution of streams and improve the water quality for domestic, municipal, and recreational uses and for wildlife.

Conservation tillage, crop rotations, winter cover crops, a permanent cover of plants, contour farming, contour stripcropping, grassed waterways, terraces, diversions, and grade-stabilization structures help to control erosion on upland soils that are suitable for tillage. Crop rotations that include grasses reduce the period that the soil is exposed to erosion. A permanent cover of plants, such as grasses and legumes grown for

hay or pasture, can reduce soil loss to a negligible amount.

A system of conservation tillage limits the extent to which the surface is disturbed. Conservation tillage methods include chiseling, discing, and leaving a protective amount of crop residue on the surface. Crop residue left on the surface increases the rate of water infiltration, improves tilth, and reduces the hazard of erosion by protecting the soil from the impact of raindrops. The greater the percentage of ground covered by crop residue, the more effective the erosion control. No-till planting is very effective in many of the sloping areas in the county.

Contour farming and contour stripcropping are effective in controlling erosion on gentle slopes. They are most effective on soils that have smooth, uniform slopes. Terraces and diversions help to control erosion by intercepting water as it travels downslope. They are most effective on deep, well drained or moderately well drained soils that have uniform slopes. Grassed waterways, tile terrace outlets, and grade-stabilization structures help to control gully erosion by disposing of excess water at a nonerosive velocity.

Wind erosion is a minor problem. It occurs mainly on soils on bottom land that are tilled in the fall or are not protected by a cover of plants or crop residue during winter and early spring. It can be controlled by maintaining a permanent cover of plants and by delaying tillage until just prior to planting.

Soil fertility is a basic management concern because it affects the productivity of all soils. Natural fertility commonly is high in Cotter, Haynie, Nodaway, Norborne, Sharpsburg, and Wakenda soils. In areas of these soils, additions of a moderate amount of nitrogen, phosphate, potash, and calcium are needed. Additions of trace elements also may be needed. Natural fertility is medium or low in Armster, Booker, Greenton, and Wabash soils. Heavy applications of fertilizer and lime are needed in areas of these soils. Soil tests are needed to determine the kind and amount of lime and fertilizer that should be applied.

Soil tilth is an important factor affecting seedbed preparation, the germination of seeds, and the infiltration of water into the soil. The content of organic matter has an important effect on tilth. Soils that have a higher content of organic matter can be tilled more easily than those that have a lower content. The soils in areas where severe erosion has removed most of the topsoil and the soils in areas where frequent tillage has broken down the soil structure are subject to surface crusting. The crust hardens when dry and thus reduces the rate of water infiltration and increases the rate of runoff. Returning crop residue to the soil helps to maintain the content of organic matter, prevent surface crusting, and keep the soil porous.

Soil drainage is a major management concern on about 67,000 acres in Carroll County. It is mainly a concern on the flood plains along the Missouri River. Aholt, Booker, Bremer, and Waldron are examples of soils in these areas. Because of the restricted permeability, excess water in areas of these soils damages crops in most years unless a surface drainage system is installed.

Many different kinds of crops and grasses are suited to the soils and climatic conditions in the survey area. Soybeans are the main crop. Corn and grain sorghum also are important row crops. Wheat is the dominant small grain crop. Oats, rye, and barley are suited to the survey area but are not widely grown.

The important grasses and legumes grown for hay and pasture are fescue, orchardgrass, bromegrass, timothy, and red clover. Deep-rooted crops, such as alfalfa, are best suited to deep, well drained or moderately well drained soils, such as Armster, Knox, Ladoga, Sharpsburg, and Wakenda soils, and to some of the soils on bottom land that are adequately drained. The major management concern on most of the pastureland is overgrazing. Grazing should be controlled so that plants can survive and achieve maximum production. Keeping grasses at a desirable height helps to control runoff and erosion.

Native warm-season grasses can grow well in the survey area but currently are not widely grown. Big bluestem, indiangrass, and switchgrass are examples of plants that could be included in a grazing system. They can produce forage during the hot, dry periods in July and August when many cool-season grasses are dormant.

Apple and peach orchards are suited to the deep, well drained Knox and Wakenda soils. Other crops that are not widely grown but have potential in the survey area are potatoes, other vegetables, strawberries, and nursery crops.

Yields per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland and for engineering purposes.

In the capability system, soils are generally grouped at three levels—capability class, subclass, and unit. Only class and subclass are used in this survey *(5)*.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations or hazards that restrict their use.

Class II soils have moderate limitations or hazards that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations or hazards that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations or hazards that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations or hazards that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations or hazards that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations or hazards that nearly preclude their use for commercial crop production.

There are no class VIII soils in Carroll County.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w,* or *s,* to the class numeral, for example, IIe. The letter *e* shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); and *s* shows that the soil is limited mainly because it is shallow, droughty, or stony.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w* or *s* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section "Detailed Soil Map Units" and in the yields table.

Woodland Management and Productivity

James L. Robinson, forester, Soil Conservation Service, helped prepare this section.

According to the 1982 National Resources Inventory, approximately 7 percent of Carroll County is forested. Knowledge of soils helps to provide a basic understanding of how forests develop. Some of the relationships between forest types and kinds of soil have been recognized for a long time. For example, white oak grows well on deep, moist soils but post oak and chinkapin oak are more prevalent where rooting depth is restricted or moisture supply is limited. The soil serves as a reservoir for moisture, provides an anchor for roots, and supplies most of the available nutrients. Soil properties that directly or indirectly affect these growth requirements include reaction, fertility, drainage,

texture, structure, and depth. Landscape position also is important.

Available water capacity is influenced primarily by texture, rooting depth, and content of stones, shale, and chert. Deep soils that have a surface layer of silt loam, such as Knox soils, have a high available water capacity. Although little can be done to change physical limitations, management of the best suited species can lessen the effect of the limitations.

The supply of nutrients affects tree growth. The layer of leaf litter on the surface of the soils is an important source of nutrients. Decomposition of this layer recycles nutrients that have accumulated in the forest ecosystem over long periods. Fire, excessive trampling by livestock, and erosion can result in loss of these nutrients. Forest management should include measures that prevent wildfires and that protect the woodland from overgrazing.

Other site characteristics that affect tree growth include aspect and position on the landscape. They influence such factors as the amount of available sunlight (or energy), air drainage, soil temperature, and moisture conditions. Generally, north and east aspects are the best upland sites for trees.

Most of the upland timber in Carroll County is in areas of the Gosport-Greenton-Sharpsburg and Knox-Higginsville-Wakenda associations. The Gosport and Knox soils support most of the timber. The Gosport soils primarily support stands of black oak, white oak, northern red oak, chinkapin oak, post oak, and hickories. They have a moderate production potential, but aspect can influence the site quality. The Knox soils have a very good production potential. They support good stands of white oak, northern red oak, black oak, black walnut, pecan, and hickories. Low-quality stands on these soils generally are a result of past management.

The Leta-Haynie-Waldron and Colo-Nodaway associations are on bottom land and include some forest land. The forestland generally is in areas that are subject to frequent flooding or that have inadequate drainage for crop production. Typical species include cottonwood, silver maple, black willow, green ash, hackberry, pecan, American elm, and boxelder. The Waldron, Colo, and Nodaway soils support some commercial pecan groves. They are highly productive and can respond to intensive management.

Table 7 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for an indicator tree species. The number indicates the volume, in cubic meters per hectare per year, which the indicator species can produce. The number 1 indicates low potential productivity; 2 and 3, moderate; 4 and 5, moderately high; 6 to 8, high; 9 to 11, very high; and 12 to 39, extremely high. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *R* indicates steep slopes; *X*, stoniness or rockiness; *W*, excess water in or on the soil; *T*, toxic substances in the soil; *D*, restricted rooting depth; *C*, clay in the upper part of the soil; *S*, sandy texture; *F*, a high content of rock fragments in the soil; and *N*, snow pack. The letter *A* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: R, X, W, T, D, C, S, F, and N.

In table 7, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Erosion hazard is the probability that damage will occur as a result of site preparation and cutting where the soil is exposed along roads, skid trails, and fire lanes and in log-handling areas. Forests that have been burned or overgrazed also are subject to erosion. Ratings of the erosion hazard are based on the percent of the slope. A rating of *slight* indicates that no particular prevention measures are needed under ordinary conditions. A rating of *moderate* indicates that erosion-control measures are needed in certain silvicultural activities. A rating of *severe* indicates that special precautions are needed to control erosion in most silvicultural activities.

Equipment limitation reflects the characteristics and conditions of the soil that restrict the use of the equipment generally needed in woodland management or harvesting. The chief characteristics and conditions considered in the ratings are slope, stones on the surface, rock outcrops, soil wetness, and texture of the surface layer. A rating of *slight* indicates that under normal conditions the kind of equipment and season of use are not significantly restricted by soil factors. Soil wetness can restrict equipment use, but the wet period does not exceed 1 month. A rating of *moderate* indicates that equipment use is moderately restricted because of one or more soil factors. If the soil is wet, the wetness restricts equipment use for a period of 1 to 3 months. A rating of *severe* indicates that equipment use is severely restricted either as to the kind of equipment that can be used or the season of use. If the soil is wet, the wetness restricts equipment use for more than 3 months.

Seedling mortality refers to the death of naturally occurring or planted tree seedlings, as influenced by the kinds of soil, soil wetness, or topographic conditions. The factors used in rating the soils for seedling mortality are texture of the surface layer, depth to a seasonal high water table and the length of the period when the water table is high, rock fragments in the surface layer, effective rooting depth, and slope aspect. A rating of *slight* indicates that seedling mortality is not likely to be a problem under normal conditions. Expected mortality is less than 25 percent. A rating of *moderate* indicates that some problems from seedling mortality can be expected. Extra precautions are advisable. Expected mortality is 25 to 50 percent. A rating of *severe* indicates that seedling mortality is a serious problem. Extra precautions are important. Replanting may be necessary. Expected mortality is more than 50 percent.

Windthrow hazard is the likelihood that trees will be uprooted by the wind because the soil is not deep enough for adequate root anchorage. The main restrictions that affect rooting are a seasonal high water table and the depth to bedrock, a fragipan, or other limiting layers. A rating of *slight* indicates that under normal conditions no trees are blown down by the wind. Strong winds may damage trees, but they do not uproot them. A rating of *moderate* indicates that some trees can be blown down during periods when the soil is wet and winds are moderate or strong. A rating of *severe* indicates that many trees can be blown down during these periods.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index* and as a *volume* number. The site index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

The *volume*, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic feet per acre per year, indicates the amount of fiber produced in a fully stocked, even-aged, unmanaged stand.

The first species listed under *common trees* for a soil is the indicator species for that soil. It generally is the most common species on the soil and is the one that determines the ordination class.

Trees to plant are those that are suitable for commercial wood production.

Windbreaks and Environmental Plantings

James L. Robinson, forester, Soil Conservation Service, helped prepare this section.

Windbreaks, including farmstead, feedlot, and field windbreaks, have potential for use in areas of the prairie soils. They protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are beneficial primarily through their influence on crop production. They tend to moderate the extremes of cold, dry, windy conditions and hot, dry, windy conditions. In years when these conditions are most extreme, field windbreaks have the greatest influence on crop yields. Research has indicated that significant increases in yields have resulted from the effects of field windbreak systems. Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. In addition to protecting cropland and crops from wind, field windbreaks help to keep snow on the fields and provide food and cover for wildlife.

Farmstead windbreaks protect the farmstead area from blowing snow, reduce the wind chill, beautify the area, and significantly reduce home heating costs. Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 8 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 8 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service or from a commercial nursery.

Recreation

Ken Kriewitz, private land specialist, Missouri Department of Conservation, helped prepare this section.

Nearly all of the land in Carroll County is privately owned. There are many farm ponds, and most of the ponds have fish. Generally, only the landowner's families and friends have access to recreational opportunities on private land.

The Missouri River and the Grand River provide opportunities for boating, swimming, and fishing. Three State-owned wildlife areas are located in Carroll County. They offer a variety of recreational activities, such as hiking, primitive camping, hunting, birdwatching, and other outdoor activities.

Carroll County has three areas that are owned by the Missouri Department of Conservation and managed for hunting and other outdoor activities. The Bunch Hollow Wildlife Area consists of 3,109 acres in the northwestern part of the county. The W.L. Schifferdecker Memorial Wildlife Area is 240 acres in size and is about 4 miles north of Norborne. The Little Compton Wildlife Area covers 345 acres, including a 40-acre fishing lake, and is 7 miles southeast of Hale.

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation also are important. Soils subject to flooding are limited for recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, or limited use or by a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils are gently sloping and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

Ken Kriewitz, private land specialist, Missouri Department of Conservation, helped prepare this section.

Carroll County has six basic soil associations. These associations are the primary factors that influence land capability and use, which directly relate to wildlife habitat. Most of Carroll County is cropland or pasture, and wildlife habitat considerations generally are secondary to agricultural interests. Wildlife in the county inhabits brushy ditches, field borders, forested stream corridors, small upland woodlots, a few large areas of woodland, and other scattered areas. Because of physical features, these wildlife areas are not cultivated.

The primary big game species in the county are the white-tailed deer and eastern wild turkey. Both species, but especially the turkey, inhabit woodland. Generally, the deer and turkey are most numerous in and around

the Gosport-Greenton-Sharpsburg soil association. However, healthy populations occur throughout the county in areas where suitable habitat is available.

Waterfowl populations are plentiful in wet periods during autumn and spring, primarily in cultivated areas along the Missouri River and on flood plains along the smaller streams. Geese and ducks are attracted to these areas because they feed on waste grain in the shallow water. The Leta-Haynie-Waldron and Colo-Nodaway associations include areas of this flood plain habitat.

Small game species include bobwhite quail, cottontail, fox squirrel, and gray squirrel. Generally, populations of these species fluctuate according to the severity of annual weather conditions. Bobwhite quail and cottontail prefer edge habitat, areas where different habitats overlap. The best populations of these two species are found in the Lagonda-Armster-Grundy and Knox-Higginsville-Wakenda associations. Like other wildlife species, however, these animals inhabit areas throughout the county that provide suitable habitat.

Squirrels are found wherever there are trees. Wooded areas in the uplands support healthy populations of squirrels. Generally, squirrels also are plentiful in small, isolated brushy areas and in wooded areas on flood plains.

In areas of good quality habitat, fluctuations in populations of quail, cottontail, and squirrels are relatively minor. The populations are healthy and stable. In areas of minimum quality habitat, the fluctuations occur frequently.

Generally, most of the furbearers found in Missouri are also common in Carroll County. Opossum, muskrat, mink, red fox, beaver, raccoon, coyote, weasel, and skunk are found throughout the county where suitable habitat is available.

Many nongame species of songbirds, small mammals, reptiles, and amphibians that are common in Missouri are found throughout Carroll County. Migratory birds also pass through and nest in the county.

Fishing in the county generally is good. Numerous farm ponds, small and intermediate-sized streams, and the area of the Missouri River that borders the southern part of the county offer a variety of fishing opportunities. The largest impoundment open to the public is the 40-acre lake in the Little Compton Wildlife Area. Catfish, largemouth bass, crappie, bluegill, and carp are the most popular fish species in the county.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 10, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flooding. Soil temperature and soil moisture also are considerations. Examples of grain and seed crops are corn, wheat, oats, and soybeans.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flooding, and slope. Soil temperature and soil moisture also are considerations. Examples of grasses and legumes are bluegrass, fescue, switchgrass, orchardgrass, indiangrass, clover, alfalfa, trefoil, and lespedeza.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface

stoniness, and flooding. Soil temperature and soil moisture also are considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, pokeweed, foxtail, croton, and partridge pea.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwoods and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, sweetgum, apple, hawthorn, dogwood, hickory, wild plum, sumac, and persimmon.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine and cedar.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, cordgrass, rushes, and sedges.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include bobwhite quail, meadowlark, field sparrow, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, thrushes, woodpeckers, squirrels, gray fox, raccoon, and deer.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, muskrat, mink, and beaver.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. Ratings are given for building site development, sanitary facilities, construction materials, and water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, the shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems,

the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. Slope and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation should be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to wind erosion.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less

exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and the shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet and have a water table at a depth of less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and *gravel* are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is as much as 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal high water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to

overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability in the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; and the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to control water erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind erosion or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

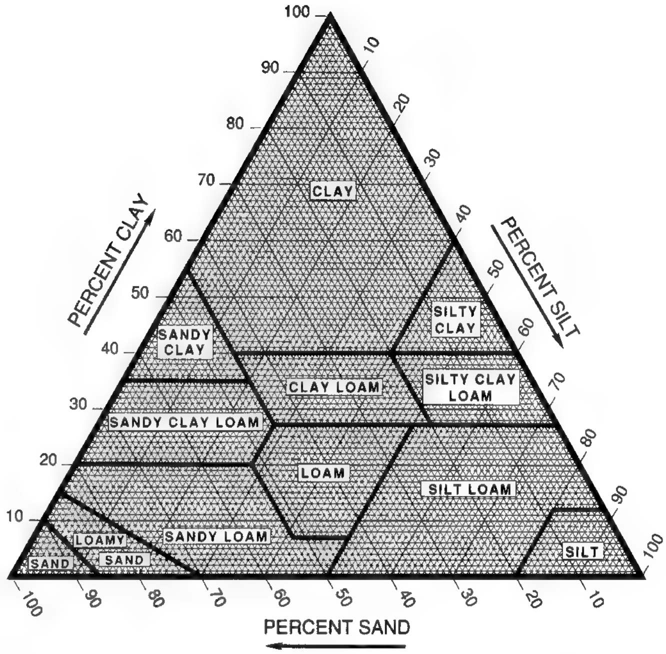

Figure 9.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Engineering Index Properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under the heading "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 9). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the "Glossary."

Classification of the soils is determined according to the Unified soil classification system *(2)* and the system adopted by the American Association of State Highway and Transportation Officials *(1)*.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and

highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated content of clay in each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at ⅓-bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for

fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

The shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion. Soils are grouped according to the following distinctions:

1. Coarse sands, sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are very slightly erodible. Crops can be grown if ordinary measures to control wind erosion are used.

7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control wind erosion are used.

8. Soils that are not subject to wind erosion because of coarse fragments on the surface or because of surface wetness.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 16, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained

sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups in table 17, the first letter is for drained areas and the second is for undrained areas.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it occurs often under normal weather conditions (the chance of flooding is more than 50 percent in any year). *Common* is used when the occasional and frequent classes are grouped for certain purposes. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 days to 1 month, and *very long* if more than 1 month. Probable dates are expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 17.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced

electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion also is expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(6)*. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 18 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Udoll *(Ud*, meaning humid, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Argiudolls *(Argi*, meaning argillic horizon, plus *udoll*, the suborder of the Mollisols that has a udic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Argiudolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, the slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-silty, mixed, mesic Typic Argiudolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" *(4)*. Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" *(6)*. Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Aholt Series

The Aholt series consists of deep, very poorly drained, very slowly permeable soils on flood plains along the Missouri River. These soils formed in

calcareous, clayey alluvium. The slopes range from 0 to 2 percent.

Typical pedon of Aholt silty clay, 1,350 feet east and 1,000 feet south of the northwest corner of sec. 19, T. 52 N., R. 25 W.

Ap—0 to 6 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; weak fine angular blocky structure parting to weak very fine granular; firm; many fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

Bg1—6 to 10 inches; black (2.5Y 2/0) silty clay, very dark gray (2.5Y 3/0) dry; few fine prominent dark yellowish brown (10YR 3/4) mottles; weak fine subangular blocky structure; very firm; common fine roots; slight effervescence; mildly alkaline; clear smooth boundary.

Bg2—10 to 19 inches; black (2.5Y 2/0) clay, very dark gray (2.5Y 3/0) dry; few fine prominent olive brown (2.5Y 4/4) and dark yellowish brown (10YR 3/4) mottles; weak fine angular and very fine subangular blocky structure; very firm; common fine roots; slight effervescence; mildly alkaline; clear smooth boundary.

Bg3—19 to 25 inches; very dark gray (2.5Y 3/0) clay, dark gray (2.5Y 4/0) dry; few fine prominent olive brown (2.5Y 4/4) mottles; moderate fine angular blocky structure; very firm; few fine roots; slight effervescence; moderately alkaline; clear smooth boundary.

Bg4—25 to 34 inches; dark gray (5Y 4/1) clay; few fine prominent olive brown (2.5Y 4/4) mottles; moderate medium angular blocky structure; very firm; few fine concretions of calcium carbonate; slight effervescence; moderately alkaline; clear smooth boundary.

Bg5—34 to 40 inches; dark gray (5Y 4/1) clay; common fine prominent brown (7.5YR 4/4) mottles; moderate fine angular blocky structure; very firm; few fine concretions of calcium carbonate; slight effervescence; moderately alkaline; clear smooth boundary.

Bg6—40 to 47 inches; dark gray (5Y 4/1) silty clay; common fine prominent brown (10YR 4/3) mottles; weak fine angular blocky structure; very firm; common fine concretions of calcium carbonate; slight effervescence; moderately alkaline; clear smooth boundary.

Cg—47 to 60 inches; dark gray (5Y 4/1) silty clay loam; few fine prominent dark yellowish brown (10YR 4/4) mottles; massive; firm; common fine concretions of calcium carbonate; slight effervescence; moderately alkaline.

The mollic epipedon is 10 to 30 inches thick and includes the upper part of the Bg horizon. The average content of clay in the 10- to 40-inch control section is more than 60 percent.

The Ap horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1 or 2. The Bg horizon is neutral in hue or has hue of 2.5Y or 5Y. It has value of 2 to 6 and chroma of 0 to 2. The Cg horizon has colors similar to those of the Bg horizon. It is silty clay loam, silty clay, or clay.

Armster Series

The Armster series consists of deep, moderately well drained, moderately slowly permeable soils on uplands. These soils formed in a thin layer of pedisediment and in the underlying Late Sangamon glacial till. The slopes range from 2 to 14 percent.

Typical pedon of Armster loam, 5 to 9 percent slopes, 1,600 feet south and 1,200 feet west of the northeast corner of sec. 21, T. 54 N., R. 23 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; many fine and medium roots; slightly acid; abrupt smooth boundary.

BE—6 to 11 inches; brown (10YR 4/3) clay loam; few fine prominent reddish brown (5YR 4/4) mottles; weak fine subangular blocky structure; friable; many fine and medium roots; common very dark grayish brown (10YR 3/2) coatings in root channels; strongly acid; clear smooth boundary.

2Bt1—11 to 14 inches; dark yellowish brown (10YR 4/4) clay loam; common fine prominent reddish brown (5YR 4/4) mottles; moderate fine subangular blocky structure; friable; common fine roots; common distinct clay films on faces of peds; strongly acid; clear smooth boundary.

2Bt2—14 to 20 inches; dark yellowish brown (10YR 4/4) clay; many medium prominent red (2.5YR 4/6) and few fine prominent strong brown (7.5YR 5/6) mottles; moderate fine angular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; strongly acid; clear smooth boundary.

2Bt3—20 to 27 inches; dark yellowish brown (10YR 4/4) clay; few fine prominent strong brown (7.5YR 5/6) mottles; weak fine subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; medium acid; clear smooth boundary.

2Bt4—27 to 39 inches; mottled strong brown (7.5YR 5/6) and light brownish gray (10YR 6/2) clay; moderate medium subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; common fine black stains and concretions

of iron and manganese oxide; neutral; gradual smooth boundary.

2Bt5—39 to 47 inches; multicolored yellowish brown (10YR 5/6), light brownish gray (2.5Y 6/2), and strong brown (7.5YR 5/6) clay; moderate medium angular and subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; common fine black stains and concretions of iron and manganese oxide; neutral; gradual smooth boundary.

2Bt6—47 to 60 inches; mottled yellowish brown (10YR 5/6) and light brownish gray (2.5Y 6/2) clay loam; common fine prominent strong brown (7.5YR 4/6) mottles; moderate medium angular blocky structure; firm; common distinct clay films on faces of peds; common fine black stains and concretions of iron and manganese oxide; neutral.

The Ap horizon has value of 2 or 3 and chroma of 1 to 3. It is loam or clay loam. The upper part of the 2Bt horizon has hue of 10YR to 5YR and value and chroma of 4 to 6. The lower part has hue of 5YR to 2.5Y, value of 4 to 6, and chroma of 2 to 8. The upper part of the argillic horizon has hue of 5YR or redder or is mottled in those colors.

Armster clay loam, 5 to 9 percent slopes, eroded, and Armster clay loam, 9 to 14 percent slopes, severely eroded, have a surface layer that is lighter colored than is defined as the range for the series. This difference, however, does not significantly affect the use and management of the soils.

Booker Series

The Booker series consists of deep, very poorly drained, very slowly permeable soils on flood plains along the Missouri River. These soils formed in clayey alluvium. The slopes range from 0 to 2 percent.

Typical pedon of Booker silty clay, 150 feet south and 2,800 feet east of the northwest corner of sec. 6, T. 51 N., R. 25 W.

Ap—0 to 5 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; weak fine granular structure; very firm; common fine roots; slightly acid; abrupt smooth boundary.

A—5 to 12 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; moderate medium angular blocky structure; very firm; few fine roots; slightly acid; clear smooth boundary.

BA—12 to 19 inches; black (10YR 2/1) clay, dark gray (10YR 4/1) dry; moderate fine angular blocky structure; very firm; few fine roots; medium acid; gradual smooth boundary.

Bg1—19 to 31 inches; very dark gray (10YR 3/1) clay, gray (10YR 5/1) dry; common fine distinct brown (10YR 4/3) mottles; moderate fine angular blocky structure; very firm; few fine roots; medium acid; gradual smooth boundary.

Bg2—31 to 39 inches; gray (N 5/0) clay; many fine prominent dark yellowish brown (10YR 4/4) mottles; weak medium subangular blocky and angular blocky structure; very firm; black (10YR 2/1) coatings on vertical pressure faces and in old root channels; slightly acid; gradual smooth boundary.

Bg3—39 to 48 inches; gray (N 5/0) clay; common fine prominent dark yellowish brown (10YR 4/4) mottles; moderate fine angular blocky structure; very firm; very dark gray (10YR 3/1) coatings on some vertical pressure faces and in old root channels; slightly acid; gradual smooth boundary.

Bg4—48 to 60 inches; gray (N 5/0) clay; common fine prominent dark yellowish brown (10YR 4/4) mottles; moderate medium angular blocky structure; very firm; common fine concretions of iron and manganese oxide; neutral.

The average content of clay in the 10- to 40-inch control section is more than 60 percent. The A horizon has value of 2 or 3 and chroma of 1 or 2. The Bg horizon has hue of 10YR to 5Y. It has value of 2 or 3 in the upper part and 4 or 5 in the lower part and has chroma of 2 or less. Distinct or prominent mottles that have hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 6 are below a depth of 18 inches. The C horizon, if it occurs, has hue of 10YR to 5Y, value of 4 or 5, and chroma of 2 or less.

Bremer Series

The Bremer series consists of deep, poorly drained, moderately slowly permeable soils on high flood plains along the Missouri River and its tributaries. These soils formed in silty and clayey alluvium. The slopes range from 0 to 2 percent.

Typical pedon of Bremer silt loam, occasionally flooded, 30 feet south and 350 feet west of the northeast corner of sec. 13, T. 53 N., R. 22 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) silt loam, very dark grayish brown (10YR 3/2) crushed, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to moderate very fine granular; friable; few fine roots; neutral; abrupt smooth boundary.

A—7 to 15 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to moderate very fine

subangular blocky; friable; few fine roots; few fine silt coatings on faces of peds; neutral; clear smooth boundary.

Bt1—15 to 22 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; few fine distinct brown (10YR 4/3) mottles; moderate very fine subangular blocky structure; friable; few fine roots; common faint clay films on faces of peds; slightly acid; clear smooth boundary.

Bt2—22 to 27 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; common fine distinct brown (10YR 4/3) mottles; moderate very fine angular and subangular blocky structure; firm; few fine roots; common faint clay films on faces of peds; common very fine black concretions of iron and manganese oxide; slightly acid; clear smooth boundary.

Btg1—27 to 34 inches; dark grayish brown (2.5Y 4/2) silty clay; many fine distinct light olive brown (2.5Y 5/4), common fine faint grayish brown (2.5Y 5/2), common fine distinct olive brown (2.5Y 4/4), and common fine prominent yellowish brown (10YR 5/6) mottles; weak fine prismatic structure parting to moderate very fine subangular blocky; firm; common distinct clay films on faces of peds; common fine concretions of iron and manganese oxide; common very dark gray organic stains; slightly acid; gradual smooth boundary.

Btg2—34 to 43 inches; grayish brown (2.5Y 5/2) silty clay; many fine distinct light olive brown (2.5Y 5/4), common fine distinct light yellowish brown (2.5Y 6/4), and many fine distinct light gray (10YR 6/1) mottles; weak fine prismatic structure parting to moderate very fine subangular blocky; firm; common distinct clay films on faces of peds; common fine yellowish brown stains and concretions of iron and manganese oxide; organic stains in old root channels; slightly acid; gradual smooth boundary.

Btg3—43 to 53 inches; gray (10YR 5/1) silty clay loam; common fine distinct light brownish gray (2.5Y 6/2), common fine prominent light olive brown (2.5Y 5/4), and common fine distinct grayish brown (2.5Y 5/2) mottles; weak fine prismatic structure parting to weak very fine subangular blocky; firm; few distinct clay films on faces of peds; few fine concretions of iron and manganese oxide; common black organic stains in old root channels; slightly acid; gradual smooth boundary.

BCg—53 to 60 inches; gray (10YR 5/1) silty clay loam; many fine distinct light brownish gray (2.5Y 6/2), many fine distinct grayish brown (2.5Y 5/2), and few fine prominent light olive brown (2.5Y 5/4) mottles; weak fine subangular blocky structure; firm; few fine concretions of iron and manganese oxide; few black organic stains in old root channels; slightly acid.

The A horizon has value of 2 or 3. It is silt loam or silty clay loam. The BCg horizon has hue of 10YR or 2.5Y and value of 4 or 5. It is mottled.

Colo Series

The Colo series consists of deep, poorly drained, moderately permeable soils on flood plains along tributaries of the Missouri River. These soils formed in silty alluvium. The slopes range from 0 to 2 percent.

Typical pedon of Colo silty clay loam, 100 feet west and 1,300 feet south of the northeast corner of sec. 14, T. 55 N., R. 23 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; common fine roots; medium acid; abrupt smooth boundary.

A1—6 to 10 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; few fine roots; slightly acid; gradual smooth boundary.

A2—10 to 19 inches; black (10YR 2/1) silty clay loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure parting to weak fine granular; friable; few fine roots; medium acid; gradual smooth boundary.

A3—19 to 33 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; weak fine subangular blocky structure; friable; few fine roots; medium acid; gradual smooth boundary.

BA—33 to 40 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; common fine distinct dark yellowish brown (10YR 3/4) mottles; weak very fine subangular blocky structure; friable; few fine roots; medium acid; gradual smooth boundary.

Bg—40 to 60 inches; black (10YR 2/1) silty clay loam, grayish brown (10YR 5/2) dry; few fine distinct dark yellowish brown (10YR 3/4) mottles; weak very fine angular blocky structure; firm; few fine roots; medium acid.

The mollic epipedon is 36 inches or more thick. The 10- to 40-inch control section averages less than 35 percent clay. Individual horizons may contain 36 to 40 percent clay.

The Bg horizon has value of 2 or 3. The BCg horizon, if it occurs, has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 2 or less. Few or common mottles that have high chroma are below a depth of 24 inches in some pedons.

Cotter Series

The Cotter series consists of deep, well drained, moderately permeable soils on flood plains along the Missouri River. These soils formed in silty alluvium. The slopes range from 0 to 2 percent.

Typical pedon of Cotter silt loam, 10 feet west and 90 feet north of the southeast corner of sec. 17, T. 52 N., R. 24 W.

Ap—0 to 8 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable; many fine roots; medium acid; abrupt smooth boundary.

A—8 to 14 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate medium and fine granular structure; friable; many fine roots; neutral; gradual smooth boundary.

Bt1—14 to 20 inches; black (10YR 2/1) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate fine subangular blocky structure; friable; many fine roots; few faint clay films on faces of peds; slightly acid; gradual smooth boundary.

Bt2—20 to 30 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 4/3) dry; moderate fine and medium subangular blocky structure; friable; many fine roots; few faint clay films on faces of peds; medium acid; gradual smooth boundary.

Bt3—30 to 40 inches; brown (10YR 4/3) silt loam; weak medium subangular blocky structure; friable; common fine roots; common distinct clay films and few black coatings of organic matter on faces of peds; strongly acid; diffuse smooth boundary.

BC—40 to 60 inches; brown (10YR 4/3) silt loam; weak medium and coarse subangular blocky structure; friable; common fine roots; few distinct black coatings of organic matter on faces of peds; medium acid.

The thickness of the mollic epipedon ranges from 24 to 36 inches. The A horizon has value of 2 or 3 and chroma of 1 or 2. The part of the B horizon that is included in the mollic epipedon has value of 2 or 3 and chroma of 1 to 3. The part below the mollic epipedon has value of 4 or 5 and chroma of 3 or 4. The C horizon, if it occurs, is silt loam or loam and may be stratified with silty clay loam or very fine sandy loam. It has value of 4 to 6 and chroma of 2 to 4. Some pedons have mottles below a depth of 48 inches.

Gilliam Series

The Gilliam series consists of deep, somewhat poorly drained, moderately permeable soils on flood plains along the Missouri River. These soils formed in silty, calcareous alluvium. The slopes range from 0 to 2 percent.

Typical pedon of Gilliam silt loam, 2,050 feet east and 150 feet north of the southwest corner of sec. 19, T. 53 N., R. 20 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; common fine roots; slight effervescence; neutral; abrupt smooth boundary.

A—6 to 16 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak very fine subangular blocky structure parting to moderate very fine granular; friable; common fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

AC—16 to 22 inches; very dark gray (10YR 3/1) silty clay loam; moderate very fine angular blocky structure; firm; few fine roots; thin strata of dark grayish brown (10YR 4/2) and very dark grayish brown (10YR 3/2) silt loam; common fine prominent dark brown stains; strong effervescence; mildly alkaline; abrupt smooth boundary.

C—22 to 54 inches; dark grayish brown (10YR 4/2) silt loam; massive; friable; thin strata of very dark gray (10YR 3/1) silty clay loam and grayish brown (10YR 5/2), brown (10YR 5/3), and dark brown (10YR 4/3) very fine sandy loam; common fine faint brown stains; strong effervescence; mildly alkaline; abrupt smooth boundary.

Ab—54 to 60 inches; very dark grayish brown (10YR 3/2) silty clay loam; common fine faint brown (10YR 4/3) mottles; moderate fine subangular blocky structure; firm; slight effervescence; mildly alkaline.

The thickness of the mollic epipedon ranges from 10 to 24 inches. The content of clay in the 10- to 40-inch control section averages 18 to 35 percent. Reaction commonly is mildly alkaline or moderately alkaline.

The Ap and A horizons have value of 2 or 3 and chroma of 1 or 2. The C horizon is silt loam or silty clay loam. It has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. Mottles, if they occur, have hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 2 to 4. The Ab horizon, if it occurs, has colors similar to those of the Ap horizon.

Gosport Series

The Gosport series consists of moderately deep, moderately well drained, very slowly permeable soils on upland side slopes. These soils formed in material weathered from shale. The slopes range from 5 to 30 percent.

Typical pedon of Gosport silty clay loam, 5 to 9 percent slopes, 125 feet north and 2,000 feet east of the southwest corner of sec. 10, T. 55 N., R. 23 W.

Ap—0 to 5 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; many fine roots; neutral; abrupt smooth boundary.

Bw1—5 to 9 inches; brown (10YR 5/3) silty clay loam; moderate very fine subangular blocky structure; firm; common fine roots; few faint grayish brown (10YR 5/2) coatings on faces of peds; common fine prominent strong brown stains; strongly acid; clear smooth boundary.

Bw2—9 to 14 inches; brown (10YR 5/3) silty clay loam; common fine prominent yellowish brown (10YR 5/8) mottles; moderate fine subangular blocky structure; firm; few fine roots; strongly acid; clear smooth boundary.

Bw3—14 to 20 inches; brown (10YR 5/3) silty clay loam; many fine prominent yellowish brown (10YR 5/8) mottles; moderate fine and medium angular blocky structure; firm; few fine roots; strongly acid; clear smooth boundary.

BC—20 to 25 inches; grayish brown (10YR 5/2) silty clay; common fine prominent yellowish brown (10YR 5/8) mottles; weak medium angular blocky structure; firm; few fine roots; few faint dark gray (10YR 4/1) coatings on faces of peds; strongly acid; clear smooth boundary.

C—25 to 32 inches; olive gray (5Y 5/2) silty clay; common fine prominent brownish yellow (10YR 6/6) and yellowish brown (10YR 5/8) mottles; massive; firm; few fine roots; about 10 percent weathered shale fragments; strongly acid; abrupt smooth boundary.

Cr—32 to 60 inches; light olive brown (2.5Y 5/4) soft, weathered shale bedrock.

The 10- to 40-inch control section averages 36 to 58 percent clay. The Ap horizon has value of 3 or 4 and chroma of 1 or 2. The E horizon, if it occurs, has value of 4 or 5 and chroma of 2 or 3. The Bw horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 3 or 4. Distinct or prominent mottles that have hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 8 are common in the Bw horizon. The C and Cr horizons vary widely in color; they have hue of 7.5YR to 5Y, value of 4 to 6, and chroma of 0 to 8.

Greenton Series

The Greenton series consists of deep, somewhat poorly drained, slowly permeable soils on uplands. These soils formed in thin deposits of loess and in the underlying clay shale and thinly bedded limestone residuum. The slopes range from 5 to 14 percent.

The Greenton soils in this county have a dark surface layer that is thinner than is defined as the range for the series. This difference, however, does not significantly affect the use and management of the soils.

Typical pedon of Greenton silty clay loam, 5 to 9 percent slopes, eroded, 2,500 feet north and 1,000 feet west of the southeast corner of sec. 16, T. 54 N., R. 22 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; many fine roots; neutral; clear smooth boundary.

Bt1—7 to 10 inches; brown (10YR 4/3) silty clay loam; common fine distinct brown (7.5YR 4/4) mottles; moderate fine subangular blocky structure; friable; common fine roots; few faint clay films on faces of peds; medium acid; clear smooth boundary.

Bt2—10 to 24 inches; dark yellowish brown (10YR 4/4) silty clay; common fine distinct grayish brown (10YR 5/2) mottles; moderate medium angular blocky structure parting to weak fine angular blocky; firm; few fine roots; common distinct clay films on faces of peds; many fine prominent reddish brown stains; medium acid; clear smooth boundary.

2Bt3—24 to 31 inches; light olive brown (2.5Y 5/4) silty clay; common fine prominent grayish brown (10YR 5/2) mottles; moderate fine angular blocky structure parting to weak fine subangular blocky; firm; few very fine roots; common distinct clay films on faces of peds; neutral; clear smooth boundary.

2BC—31 to 41 inches; yellowish brown (10YR 5/6) silty clay; common fine prominent grayish brown (10YR 5/2) and common fine distinct strong brown (7.5YR 5/6) mottles; massive; firm; few very fine roots; few fine black stains and concretions of iron and manganese oxide; mildly alkaline; clear smooth boundary.

2Cg1—41 to 52 inches; mixed grayish brown (2.5Y 5/2), strong brown (7.5YR 5/6), and yellowish brown (10YR 5/6) silty clay; massive; firm; few very fine roots; mildly alkaline; abrupt smooth boundary.

2Cg2—52 to 60 inches; mixed olive gray (5Y 5/2), strong brown (7.5YR 5/6), and yellowish brown (10YR 5/6) silty clay; massive; firm; mildly alkaline.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The Bt horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 3 to 5. It has mottles with chroma of 2 or less within 6 inches of the lower boundary of the mollic epipedon. The 2Bt horizon has hue of 7.5YR to 2.5Y, value of 4 or 5, and chroma of 2 to 4. It is silty clay or silty clay loam. Mottles that have

high chroma are distinct or prominent. The 2C horizon has value of 5 or 6 and chroma of 2 to 6.

Grundy Series

The Grundy series consists of deep, somewhat poorly drained, slowly permeable soils on uplands. These soils formed in loess. The slopes range from 2 to 5 percent.

Typical pedon of Grundy silt loam, 2 to 5 percent slopes, 2,300 feet east and 600 feet north of the southwest corner of sec. 12, T. 55 N., R. 23 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak very fine granular structure; friable; many medium and fine roots; medium acid; abrupt smooth boundary.

AB—8 to 13 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; weak very fine subangular blocky structure parting to weak fine granular; friable; many fine roots; medium acid; clear smooth boundary.

Btg1—13 to 18 inches; dark grayish brown (10YR 4/2) silty clay; common fine prominent brown (7.5YR 4/4) and common medium prominent yellowish red (5YR 4/6) mottles; weak fine subangular blocky structure; very firm; common fine roots; many distinct clay films on faces of peds; medium acid; clear smooth boundary.

Btg2—18 to 29 inches; grayish brown (10YR 5/2) silty clay; common medium prominent yellowish red (5YR 4/6) mottles; weak fine subangular blocky structure; very firm; few fine roots; many distinct clay films on faces of peds; common fine black stains and concretions of iron and manganese oxide; slightly acid; clear smooth boundary.

Btg3—29 to 40 inches; grayish brown (2.5Y 5/2) silty clay loam; few medium prominent yellowish red (5YR 4/6) mottles; moderate fine subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; few fine black stains and concretions of iron and manganese oxide; slightly acid; abrupt smooth boundary.

Btg4—40 to 45 inches; grayish brown (2.5Y 5/2) silty clay loam; common medium prominent yellowish red (5YR 4/6) mottles; moderate medium subangular blocky structure; firm; few distinct clay films on faces of peds; common fine black stains; slightly acid; abrupt smooth boundary.

Btg5—45 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam; few medium prominent yellowish red (5YR 4/6) mottles; moderate medium subangular blocky structure; firm; few distinct clay films on faces of peds; neutral.

The mollic epipedon ranges from 11 to 18 inches in thickness. The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The AB horizon has colors similar to those of the Ap horizon. The upper part of the Btg horizon has hue of 10YR or 2.5Y, value of 3 or 4, and chroma of 1 to 3. The lower part has hue of 10YR to 5Y, value of 4 or 5, and chroma of 1 or 2. This horizon has mottles with hue of 5YR to 10YR, value of 4 or 5, and chroma of 2 to 6. The Cg horizon, if it occurs, has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. It commonly has mottles with chroma of 4 to 6.

Haynie Series

The Haynie series consists of deep, moderately well drained, moderately permeable soils on flood plains along the Missouri River. These soils formed in calcareous, silty or loamy alluvium. The slopes range from 0 to 2 percent.

Typical pedon of Haynie very fine sandy loam, 750 feet west and 4,250 feet south of the northeast corner of sec. 20, T. 51 N., R. 25 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) very fine sandy loam, grayish brown (10YR 5/2) dry; few fine faint brown (10YR 4/3) mottles; weak very fine granular structure; very friable; common fine roots; slight effervescence; moderately alkaline; abrupt smooth boundary.

C1—9 to 39 inches; dark grayish brown (10YR 4/2) very fine sandy loam; massive; very friable; few fine roots; thin strata of grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) silt loam, and brown (10YR 4/3) fine sandy loam; few black stains; strong effervescence; moderately alkaline; gradual smooth boundary.

C2—39 to 60 inches; dark grayish brown (10YR 4/2) silt loam; common fine faint grayish brown (10YR 5/2) and brown (10YR 4/3) mottles; massive; friable; few thin strata of very dark grayish brown (10YR 3/2) silty clay loam; strong effervescence; moderately alkaline.

The control section contains free carbonates throughout. The thickness of the Ap horizon is 6 to 10 inches. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. In some pedons it has mottles with hue of 10YR or 7.5YR, value of 3 to 5, and chroma of 2 to 8. Most pedons have strata of coarser or finer textured material.

Higginsville Series

The Higginsville series consists of deep, somewhat poorly drained, moderately permeable soils on uplands.

These soils formed in loess. The slopes range from 5 to 9 percent.

The Higginsville soils in this county have a dark surface layer that is thinner than is defined as the range for the series. This difference, however, does not significantly affect the use and management of the soils.

Typical pedon of Higginsville silt loam, 5 to 9 percent slopes, eroded, 200 feet west and 1,900 feet north of the southeast corner of sec. 34, T. 53 N., R. 22 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; few fine faint dark brown (10YR 3/3) mottles; moderate fine granular structure; friable; common fine roots; neutral; abrupt smooth boundary.

Bt1—7 to 12 inches; dark grayish brown (10YR 4/2) silty clay loam; many fine faint brown (10YR 4/3) mottles; moderate very fine subangular blocky structure; firm; common fine roots; few faint clay films on faces of peds; slightly acid; clear smooth boundary.

Bt2—12 to 19 inches; dark grayish brown (10YR 4/2) silty clay loam; many fine faint brown (10YR 4/3) and common fine distinct dark yellowish brown (10YR 4/4) mottles; moderate very fine subangular blocky structure; firm; few fine roots; few faint clay films on faces of peds; common fine strong brown stains and few fine concretions of iron and manganese oxide; slightly acid; clear smooth boundary.

Btg—19 to 39 inches; dark grayish brown (2.5Y 4/2) silty clay loam; common fine distinct olive brown (2.5Y 4/4) mottles; moderate fine subangular blocky structure; firm; few fine roots; common faint clay films on faces of peds; common fine strong brown stains and few fine concretions of iron and manganese oxide; medium acid; gradual smooth boundary.

BCg—39 to 51 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine distinct olive brown (2.5Y 4/4) and common fine faint dark grayish brown (2.5Y 4/2) mottles; weak medium subangular blocky structure; firm; few fine roots; common fine strong brown stains and few fine concretions of iron and manganese oxide; slightly acid; gradual smooth boundary.

Cg—51 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine distinct olive brown (2.5Y 4/4) and common medium faint dark grayish brown (2.5Y 4/2) mottles; massive; friable; common fine strong brown stains and few fine concretions of iron and manganese oxide; slightly acid.

The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The Bt horizon has value of 3 to 5 and chroma of 2 or 3. The Cg horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It is silty clay loam or silt loam.

Hodge Series

The Hodge series consists of deep, somewhat excessively drained, rapidly permeable soils on flood plains along the Missouri River. These soils formed in calcareous, sandy alluvium. The slopes range from 0 to 2 percent.

Typical pedon of Hodge loamy fine sand, 2,520 feet west and 1,840 feet north of the southeast corner of sec. 17, T. 51 N., R. 23 W.

Ap—0 to 6 inches; dark brown (10YR 3/3) loamy fine sand, grayish brown (10YR 5/2) dry; single grain; loose; slight effervescence; mildly alkaline; abrupt smooth boundary.

C1—6 to 36 inches; dark grayish brown (10YR 4/2) fine sand; single grain; loose; strong effervescence; mildly alkaline; abrupt smooth boundary.

C2—36 to 48 inches; dark grayish brown (10YR 4/2) loamy fine sand; common fine faint brown (10YR 4/3) mottles; massive; very friable; thin strata of fine sandy loam and very fine sandy loam; common very dark grayish brown organic stains at a depth of 36 to 38 inches; strong effervescence; mildly alkaline; abrupt smooth boundary.

C3—48 to 60 inches; mottled dark grayish brown (10YR 4/2) and brown (10YR 4/3) loamy fine sand; single grain; loose; common thin strata of fine sand; strong effervescence; mildly alkaline.

The Ap horizon has value of 3 or 4 and chroma of 2 or 3. The C horizon has value of 4 or 5.

Kenmoor Series

The Kenmoor series consists of deep, moderately well drained soils on flood plains along the Missouri River. Permeability is rapid in the upper part of the profile and slow in the lower part. These soils formed in sandy, calcareous alluvium over clayey, calcareous alluvium. The slopes range from 0 to 2 percent.

Typical pedon of Kenmoor loamy fine sand, 250 feet north and 60 feet east of the southwest corner of sec. 11, T. 51 N., R. 24 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) loamy fine sand, light brownish gray (10YR 6/2) dry; weak fine granular structure; very friable; common fine roots; strong effervescence; neutral; abrupt smooth boundary.

C—6 to 28 inches; grayish brown (10YR 5/2), stratified loamy fine sand and fine sand; single grain; loose; common fine roots; strong effervescence; mildly alkaline; abrupt smooth boundary.

2Ab—28 to 37 inches; very dark grayish brown (10YR 3/2) silty clay; moderate fine and very fine blocky and subangular blocky structure; firm; few fine roots; slight effervescence; neutral; clear smooth boundary.

2Bb—37 to 60 inches; grayish brown (10YR 4/2) silty clay; common medium prominent yellowish brown (10YR 5/6) mottles; moderate medium angular blocky structure; firm; strong effervescence; mildly alkaline.

The soils are calcareous throughout. The thickness of the A horizon is 4 to 10 inches. The Ap horizon has value of 3 or 4 and chroma of 2 or 3. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 or 3. The 2Ab horizon has hue of 10YR or 2.5Y and value of 2 or 3. In some pedons it has mottles with higher value and chroma. It is silty clay or silty clay loam. The 2Bb horizon has hue of 10YR or 2.5Y and value of 4 or 5. It is silty clay or silty clay loam. Strata of lighter textures are common.

Knox Series

The Knox series consists of deep, well drained, moderately permeable soils on uplands adjacent to the flood plains along the Missouri River. These soils formed in loess. The slopes range from 5 to 30 percent.

Typical pedon of Knox silt loam, 5 to 9 percent slopes, eroded, 2,250 feet north and 125 feet east of the southwest corner of sec. 27, T. 53 N., R. 21 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; mixed with a few streaks and pockets of brown (10YR 4/3) subsoil material; moderate very fine granular structure; friable; common fine roots; neutral; abrupt smooth boundary.

Bt1—6 to 11 inches; brown (10YR 4/3) silty clay loam; moderate very fine subangular blocky structure; firm; common fine roots; few faint clay films on faces of some peds; slightly acid; clear smooth boundary.

Bt2—11 to 16 inches; brown (10YR 4/3) silty clay loam; moderate very fine subangular blocky structure; firm; few fine roots; few faint clay films on faces of peds; medium acid; clear smooth boundary.

Bt3—16 to 36 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate fine subangular blocky structure; firm; few fine roots; common faint clay films on faces of peds; medium acid; gradual smooth boundary.

BC—36 to 46 inches; brown (10YR 4/3) silty clay loam; few fine faint brown (10YR 5/3) mottles; weak medium subangular blocky structure; firm; few fine roots; few fine black stains; medium acid; gradual smooth boundary.

C—46 to 60 inches; brown (10YR 4/3) silt loam; common fine faint grayish brown (10YR 5/2) and dark yellowish brown (10YR 4/4) mottles; massive; friable; few fine black stains; slightly acid.

The depth to free carbonates is more than 60 inches. The Ap horizon has chroma of 2 or 3. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. The content of clay in the finest textured part of this horizon ranges from 25 to 35 percent. The C horizon has matrix colors similar to those of the Bt horizon.

Knox silty clay loam, 9 to 14 percent slopes, severely eroded, has a surface layer that is thinner and lighter colored than is defined as the range for the series. This difference, however, does not significantly affect the use and management of the soils.

Ladoga Series

The Ladoga series consists of deep, moderately well drained, moderately slowly permeable soils on uplands. These soils formed in loess. The slopes range from 2 to 9 percent.

Typical pedon of Ladoga silt loam, 2 to 5 percent slopes, 225 feet south and 500 feet east of the northwest corner of sec. 33, T. 55 N., R. 24 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; friable; common fine roots; neutral; abrupt smooth boundary.

Bt1—7 to 15 inches; brown (10YR 4/3) silty clay loam; weak very fine subangular blocky structure; friable; common fine roots; few faint clay films on faces of peds; neutral; clear smooth boundary.

Bt2—15 to 19 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate very fine subangular blocky structure; firm; few fine roots; common faint clay films and few silt coatings on faces of peds; medium acid; clear smooth boundary.

Bt3—19 to 25 inches; dark yellowish brown (10YR 4/4) silty clay loam; moderate very fine subangular blocky structure; firm; few fine roots; common faint clay films and few silt coatings on faces of peds; few fine black stains and concretions of iron and

manganese oxide; strongly acid; clear smooth boundary.

Bt4—25 to 40 inches; brown (10YR 4/3) silty clay loam; common fine faint grayish brown (10YR 5/2) and few fine distinct dark yellowish brown (10YR 4/6) mottles; moderate fine prismatic structure parting to moderate fine subangular blocky; firm; few fine roots; common faint clay films on faces of peds; common fine black stains and concretions of iron and manganese oxide; strongly acid; gradual smooth boundary.

Bt5—40 to 51 inches; dark yellowish brown (10YR 4/4) silty clay loam; common fine distinct grayish brown (10YR 5/2) and dark yellowish brown (10YR 4/6) mottles; moderate fine prismatic structure parting to moderate fine subangular blocky; firm; common distinct clay films and few silt coatings on faces of peds; few fine black stains and concretions of iron and manganese oxide; strongly acid; gradual smooth boundary.

BC—51 to 60 inches; yellowish brown (10YR 5/4) silty clay loam; common fine distinct grayish brown (10YR 5/2) and dark grayish brown (10YR 4/2) and common fine faint brown (10YR 4/3) mottles; weak medium subangular blocky structure; friable; few fine black stains and concretions of iron and manganese oxide; strongly acid.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The E horizon, if it occurs, has value of 4 or 5. The Bt horizon has hue of 10YR or 7.5YR. It typically is silty clay loam, but the range includes silty clay. The C horizon, if it occurs, has value of 4 or 5 and chroma of 3 or 4.

Lagonda Series

The Lagonda series consists of deep, somewhat poorly drained, slowly permeable soils on uplands. These soils formed in a thin layer of loess and in more than 20 inches of weathered pedisediment, which overlies glacial till. The slopes range from 2 to 9 percent.

Typical pedon of Lagonda silt loam, 2 to 5 percent slopes, 2,000 feet east and 200 feet south of the northwest corner of sec. 3, T. 55 N., R. 23 W.

Ap—0 to 7 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; many fine roots; slightly acid; abrupt smooth boundary.

A—7 to 11 inches; black (10YR 2/1) silty clay loam, very dark brown (10YR 2/2) crushed, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to weak fine and medium granular; friable; many fine roots; medium acid; clear smooth boundary.

Bt1—11 to 16 inches; dark grayish brown (10YR 4/2) silty clay loam; moderate fine subangular blocky structure; friable; many fine roots; common faint clay films on faces of peds; medium acid; clear smooth boundary.

Bt2—16 to 22 inches; dark grayish brown (10YR 4/2) silty clay loam; common fine distinct yellowish brown (10YR 5/4) mottles; moderate fine and medium subangular blocky structure; firm; many fine roots; common faint clay films on faces of peds; few fine black stains and concretions of iron and manganese oxide; medium acid; gradual smooth boundary.

Btg1—22 to 30 inches; dark grayish brown (2.5Y 4/2) silty clay; many fine prominent yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; very firm; common fine roots; common distinct clay films on faces of peds; few fine stains and concretions of iron and manganese oxide; few fine sand grains; medium acid; gradual smooth boundary.

2Btg2—30 to 40 inches; grayish brown (2.5Y 5/2) silty clay; many fine prominent yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; very firm; few fine roots; common distinct clay films on faces of peds; few fine stains and concretions of iron and manganese oxide; common fine sand grains and few fine pebbles; neutral; gradual smooth boundary.

2Btg3—40 to 47 inches; grayish brown (2.5Y 5/2) silty clay; common medium prominent yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; very firm; few fine roots; common distinct clay films on faces of peds; few fine stains and concretions of iron and manganese oxide; common sand grains and few pebbles; neutral; gradual smooth boundary.

2Btg4—47 to 60 inches; grayish brown (2.5Y 5/2) clay; common medium prominent yellowish brown (10YR 5/4) mottles; moderate fine angular blocky structure; very firm; few distinct clay films on faces of peds; few fine stains and concretions of iron and manganese oxide; few fine pebbles; neutral.

The thickness of the mollic epipedon ranges from 10 to 24 inches. A marked increase in the content of sand ranges from a depth of 20 to 36 inches.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It typically is silt loam, but the range includes silty clay loam. The Bt horizon has hue of 10YR or 2.5Y,

value of 3 or 4, and chroma of 2 to 4. It is silty clay loam or silty clay. The 2Btg horizon has hue of 10YR to 5Y, value of 4 or 5, and chroma of 1 or 2. It is silty clay loam, silty clay, or clay. The content of sand in this horizon is more than 5 percent.

Lagonda silty clay loam, 5 to 9 percent slopes, eroded, has a dark surface layer that is thinner than is defined as the range for the series. This difference, however, does not significantly affect the use and management of the soils.

Landes Series

The Landes series consists of deep, well drained, rapidly permeable soils on flood plains along the Missouri River. These soils formed in loamy and sandy alluvium. The slopes range from 0 to 2 percent.

The Landes soils in this county have more sand in the lower part of the profile than is defined as the range for the series. This difference, however, does not significantly affect the use and management of the soils.

Typical pedon of Landes fine sandy loam, 1,550 feet north and 50 feet east of the southwest corner of sec. 29, T. 52 N., R. 25 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; few fine roots; neutral; abrupt smooth boundary.

A—7 to 20 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; few fine roots; neutral; clear smooth boundary.

Bw—20 to 33 inches; brown (10YR 4/3) loamy fine sand; weak fine subangular blocky structure; friable; slightly acid; gradual smooth boundary.

C1—33 to 43 inches; brown (10YR 4/3) loamy fine sand; common fine faint dark yellowish brown (10YR 4/4) mottles; massive; very friable; slightly acid; gradual smooth boundary.

C2—43 to 60 inches; mottled brown (10YR 4/3) and dark yellowish brown (10YR 4/4) fine sand; common fine distinct grayish brown (10YR 5/2) mottles; single grain; loose; slightly acid.

The mollic epipedon ranges from 10 to 24 inches in thickness. The A horizon has value and chroma of 2 or 3. The B horizon has value of 4 or 5 and chroma of 3 or 4. It dominantly is loamy fine sand, but the range includes sandy loam and fine sandy loam. The C horizon has value of 4 to 6. It is fine sand, loamy fine sand, or sandy loam.

Leta Series

The Leta series consists of deep, somewhat poorly drained soils on flood plains along the Missouri River. Permeability is slow in the upper part of the profile and moderate in the lower part. These soils formed in calcareous, clayey alluvium over calcareous, silty and loamy alluvium. The slopes range from 0 to 2 percent.

Typical pedon of Leta silty clay, 225 feet north and 250 feet west of the southeast corner of sec. 24, T. 53 N., R. 21 W.

Ap—0 to 5 inches; very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; moderate fine granular structure; firm; few fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

A—5 to 12 inches; very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; moderate very fine subangular blocky structure; firm; few fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

Bw—12 to 25 inches; very dark grayish brown (10YR 3/2) silty clay; few fine distinct dark yellowish brown (10YR 4/4) mottles; moderate fine subangular blocky structure; firm; few fine roots; few thin strata of dark grayish brown (10YR 4/2) silt loam; slight effervescence; mildly alkaline; clear smooth boundary.

2C1—25 to 50 inches; stratified dark grayish brown (10YR 4/2) and very dark grayish brown (10YR 3/2) very fine sandy loam; common fine faint brown (10YR 4/3) mottles; massive; very friable; strong effervescence; mildly alkaline; clear smooth boundary.

2C2—50 to 60 inches; stratified dark grayish brown (2.5Y 4/2) silt loam and brown (10YR 4/3) very fine sandy loam; common fine distinct brown (10YR 5/3) mottles; massive; friable; few fine stains of iron and manganese oxide; strong effervescence; mildly alkaline.

The clayey upper part of the profile ranges from 20 to 38 inches in thickness. The mollic epipedon ranges from 10 to about 20 inches in thickness. The soils have free carbonates within a depth of 10 inches.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The B horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 1 to 3. Where it has value of 3 below a depth of 24 inches, the horizon is separated from the mollic epipedon by strata with higher value. The solum is silty clay or silty clay loam in which the content of clay ranges from 35 to 48 percent. The 2C horizon has value of 4 or 5 and chroma of 1 or 2. It commonly is stratified silt loam and very fine sandy loam. Most

pedons have thin strata of finer or coarser textured material.

Nodaway Series

The Nodaway series consists of deep, moderately well drained, moderately permeable soils on flood plains or alluvial fans along tributaries of the Missouri River. These soils formed in recent silty alluvium. The slopes range from 0 to 2 percent.

Typical pedon of Nodaway silt loam, 2,200 feet east and 2,640 feet south of the northwest corner of sec. 12, T. 52 N., R. 23 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate very fine granular structure; friable; common fine roots; neutral; abrupt smooth boundary.

C1—6 to 25 inches; stratified very dark grayish brown (10YR 3/2), dark grayish brown (10YR 4/2), and brown (10YR 4/3) silt loam; massive; friable; few fine roots; few fine prominent brown organic stains; neutral; abrupt smooth boundary.

C2—25 to 60 inches; stratified very dark grayish brown (10YR 3/2), dark grayish brown (10YR 4/2), brown (10YR 4/3), and grayish brown (10YR 5/2) silt loam; massive; friable; few fine roots; few fine prominent brown organic stains; neutral.

The Ap horizon has chroma of 1 or 2. The C horizon has chroma of 1 to 4. It typically is silt loam, but the range includes silty clay loam. Many profiles have thin strata of very fine sandy loam.

Norborne Series

The Norborne series consists of deep, well drained, moderately permeable soils in the slightly higher areas on flood plains along the Missouri River. These soils formed in loamy, stratified alluvium. The slopes range from 0 to 2 percent.

Typical pedon of Norborne loam, 1,620 feet east and 1,600 feet south of the northwest corner of sec. 18, T. 51 N., R. 25 W.

Ap—0 to 5 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate very fine granular structure; friable; common fine roots; neutral; abrupt smooth boundary.

A—5 to 14 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure parting to moderate very fine granular; friable; few fine roots; neutral; clear smooth boundary.

Bt1—14 to 25 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; mixed with some dark brown (10YR 3/3) loam in the lower part; moderate fine subangular blocky structure; friable; few fine roots; few faint clay films on faces of peds; slightly acid; clear smooth boundary.

Bt2—25 to 35 inches; brown (10YR 4/3) loam; mixed with some very dark grayish brown (10YR 3/2) loam in the upper part; moderate very fine subangular blocky structure; friable; few fine roots; few faint clay films on faces of peds; slightly acid; gradual smooth boundary.

Bt3—35 to 46 inches; brown (10YR 4/3) loam; weak medium subangular blocky structure; friable; few fine roots; few faint clay films on faces of peds; neutral; gradual smooth boundary.

BC—46 to 53 inches; brown (10YR 5/3) very fine sandy loam; few fine faint brown (10YR 4/3) mottles; weak medium subangular blocky structure; very friable; few fine roots; common uncoated sand grains; slightly acid; gradual smooth boundary.

C—53 to 60 inches; brown (10YR 5/3) fine sandy loam; massive; loose; neutral.

The mollic epipedon is more than 24 inches thick and extends into the B horizon. The A horizon has value of 2 or 3 and chroma of 1 to 3. The B horizon has value of 2 or 3. It has chroma of 2 or 3 in the upper part and chroma of 3 or 4 in the lower part. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. It commonly is very fine sandy loam or fine sandy loam, but the range includes loam, silt loam, or loamy very fine sand.

Parkville Series

The Parkville series consists of deep, somewhat poorly drained soils on flood plains along the Missouri River. Permeability is very slow in the upper part of the profile and moderate in the lower part. These soils formed in calcareous, silty and clayey alluvium over calcareous, silty and loamy alluvium. The slopes range from 0 to 2 percent.

Typical pedon of Parkville silty clay loam, 1,475 feet east and 275 feet north of the southwest corner of sec. 36, T. 53 N., R. 21 W.

Ap1—0 to 4 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; firm; few fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

Ap2—4 to 10 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; moderate fine subangular and angular blocky structure; firm; few fine roots; slight effervescence; mildly alkaline; clear smooth boundary.

A—10 to 17 inches; very dark grayish brown (10YR 3/2) silty clay, dark grayish brown (10YR 4/2) dry; moderate very fine subangular blocky structure; firm; few organic coatings on faces of peds; slight effervescence; mildly alkaline; abrupt smooth boundary.

2C—17 to 60 inches; stratified dark grayish brown (10YR 4/2), grayish brown (10YR 5/2), and brown (10YR 4/3 and 5/3) very fine sandy loam and silt loam; massive; very friable; 2-inch strata of very dark grayish brown (10YR 3/2) silty clay loam at a depth of about 38 inches and 1-inch strata of very dark gray (10YR 3/1) silty clay loam at a depth of about 52 inches; strong effervescence; mildly alkaline.

The mollic epipedon ranges from 10 to 20 inches in thickness. The thickness of the solum ranges from 12 to 20 inches. The soils are calcareous throughout.

The A horizon has value of 2 or 3. The B horizon, if it occurs, has hue of 10YR or 2.5Y. It is silty clay loam or silty clay. The 2C horizon has hue of 10YR or 2.5Y. It is silt loam, very fine sandy loam, or loamy very fine sand and has strata of coarser or finer textured material.

Sampsel Series

The Sampsel series consists of deep, poorly drained, slowly permeable soils on foot slopes in the uplands. These soils formed in material weathered from shale. The slopes range from 2 to 5 percent.

Typical pedon of Sampsel silty clay loam, 2 to 5 percent slopes, 1,150 feet west and 1,625 feet south of the northeast corner of sec. 1, T. 54 N., R. 24 W.

Ap—0 to 5 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to moderate very fine granular; friable; common fine roots; few fine concretions of iron and manganese oxide; neutral; abrupt smooth boundary.

A—5 to 11 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak very fine subangular blocky structure; firm; common fine roots; few fine concretions of iron and manganese oxide; slightly acid; clear smooth boundary.

BA—11 to 16 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; common fine distinct dark yellowish brown (10YR 4/4) mottles; moderate very fine subangular blocky structure; firm; few fine roots; few fine concretions of iron and manganese oxide; slightly acid; clear smooth boundary.

Btg1—16 to 23 inches; dark grayish brown (10YR 4/2) silty clay; common fine distinct dark yellowish brown (10YR 4/4) and common fine faint brown (10YR 4/3) mottles; moderate very fine subangular blocky structure; very firm; few fine roots; common faint clay films on faces of peds; few fine concretions of iron and manganese oxide; slightly acid; clear smooth boundary.

Btg2—23 to 36 inches; grayish brown (2.5Y 5/2) silty clay; common fine distinct light olive brown (2.5Y 5/4) and few fine prominent light olive brown (2.5Y 5/6) mottles; moderate fine prismatic structure parting to moderate very fine subangular blocky; firm; few fine roots; common distinct clay films on faces of peds and in old root channels; common fine black stains and concretions of iron and manganese oxide; slightly acid; gradual smooth boundary.

Btg3—36 to 55 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine distinct light olive brown (2.5Y 5/4) and common medium prominent dark yellowish brown (10YR 4/6) mottles; weak fine prismatic structure parting to moderate fine subangular blocky; firm; common distinct clay films on faces of peds and in old root channels; common fine black stains and concretions of iron and manganese oxide; neutral; gradual smooth boundary.

BCg—55 to 70 inches; olive gray (5Y 5/2) silty clay loam; common fine faint olive (5Y 5/3) and common fine prominent dark yellowish brown (10YR 4/6) mottles; weak fine subangular blocky structure; firm; some very dark gray (10YR 3/1) coatings in old root channels; neutral.

The mollic epipedon is 10 to 20 inches thick. The Ap horizon has value of 2 or 3 and chroma of 1 or 2. The BA horizon has colors similar to those of the Ap horizon. The Btg horizon has hue of 10YR to 5Y, value of 3 to 6, and chroma of 1 or 2.

Sharpsburg Series

The Sharpsburg series consists of deep, moderately well drained, moderately slowly permeable soils on uplands. These soils formed in loess. The slopes range from 2 to 9 percent.

Typical pedon of Sharpsburg silt loam, 2 to 5 percent slopes, 225 feet south and 1,930 feet east of the northwest corner of sec. 34, T. 54 N., R. 24 W.

Ap—0 to 5 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate very fine granular structure; friable; many fine roots; slightly acid; abrupt smooth boundary.

A—5 to 10 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak

very fine subangular blocky structure parting to moderate very fine granular; friable; many fine roots; medium acid; clear smooth boundary.

AB—10 to 15 inches; dark brown (10YR 3/3) silty clay loam, brown (10YR 4/3) dry; moderate fine subangular blocky structure; friable; many fine roots; very dark grayish brown (10YR 3/2) coatings on faces of peds; medium acid; clear smooth boundary.

Bt1—15 to 20 inches; brown (10YR 4/3) silty clay loam; moderate fine subangular blocky structure; firm; common fine roots; common faint clay films on faces of peds; medium acid; clear smooth boundary.

Bt2—20 to 27 inches; brown (10YR 4/3) silty clay loam; moderate fine subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; medium acid; clear smooth boundary.

Bt3—27 to 33 inches; dark yellowish brown (10YR 4/4) silty clay loam; few fine distinct grayish brown (10YR 5/2) mottles; moderate very fine subangular blocky structure; firm; few fine roots; common distinct clay films on faces of peds; few fine black stains; medium acid; clear smooth boundary.

Bt4—33 to 42 inches; dark yellowish brown (10YR 4/4) silty clay loam; common fine faint brown (10YR 4/3) and common fine distinct grayish brown (10YR 5/2) mottles; moderate fine subangular blocky structure; firm; many distinct clay films on faces of peds; medium acid; gradual smooth boundary.

Bt5—42 to 50 inches; brown (10YR 4/3) silty clay loam; many medium faint grayish brown (10YR 5/2) and common fine faint dark yellowish brown (10YR 4/4) mottles; moderate fine prismatic structure parting to moderate fine subangular blocky; firm; few distinct clay films on faces of peds; few fine black and brown stains; medium acid; gradual smooth boundary.

BC—50 to 60 inches; brown (10YR 4/3) silty clay loam; common fine faint grayish brown (10YR 5/2) and dark yellowish brown (10YR 4/4) and few fine distinct dark yellowish brown (10YR 4/6) mottles; weak fine prismatic structure parting to weak very fine subangular blocky; firm; common fine black stains and few fine concretions of iron and manganese oxide; medium acid.

The mollic epipedon ranges from 10 to 20 inches in thickness. The A horizon has value of 2 or 3 and chroma of 1 to 3. The Bt horizon has value of 4 or 5. The content of clay in this horizon ranges from 36 to 42 percent. The BC horizon has colors and textures similar to those in the lower part of the Bt horizon.

Sharpsburg silt loam, 5 to 9 percent slopes, eroded, has a surface layer that is thinner than is defined as the range for the series. This difference, however, does not significantly affect the use and management of the soils.

Wabash Series

The Wabash series consists of deep, very poorly drained, very slowly permeable soils on flood plains along tributaries of the Missouri River. These soils formed in clayey alluvium. The slopes are 0 to 1 percent.

Typical pedon of Wabash silty clay, 2,550 feet south and 2,300 feet east of the northwest corner of sec. 13, T. 53 N., R. 21 W.

Ap—0 to 4 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; moderate fine granular structure; firm; few fine roots; neutral; abrupt smooth boundary.

A—4 to 14 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; moderate very fine subangular blocky structure; very firm; few fine roots; slightly acid; clear smooth boundary.

Bg1—14 to 29 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; weak fine prismatic structure parting to moderate fine subangular blocky; very firm; few fine roots; slightly acid; gradual smooth boundary.

Bg2—29 to 39 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; moderate very fine subangular blocky structure; very firm; few fine roots; slightly acid; clear smooth boundary.

Bg3—39 to 51 inches; dark grayish brown (2.5Y 4/2) silty clay; common fine distinct olive brown (2.5Y 4/4) and few fine distinct brown (10YR 4/3) mottles; moderate fine subangular blocky structure; very firm; few fine roots; few faint dark gray (10YR 4/1) coatings on faces of peds; slightly acid; gradual smooth boundary.

Bg4—51 to 60 inches; dark grayish brown (2.5Y 4/2) silty clay; common fine distinct olive brown (2.5Y 4/4) and brown (10YR 4/3) and few fine prominent dark yellowish brown (10YR 4/4) mottles; moderate very fine subangular blocky structure; very firm; few fine roots; few faint dark gray (10YR 4/1) coatings on faces of peds; slightly acid.

The depth to free carbonates is more than 40 inches. The content of clay in the 10- to 40-inch control section ranges from 46 to 60 percent.

The A horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 2 or less. The matrix colors of the B horizon to a depth of 36 inches or more are the same

as those of the A horizon. The lower part of the B horizon has the same range in hue and chroma as the upper part, but it commonly has higher value, which ranges to 5. Mottles have hue of 7.5YR to 2.5Y, value of 4 or 5, and chroma of 2 to 6. The C horizon, if it occurs, has colors and textures similar to those in the lower part of the B horizon.

Wakenda Series

The Wakenda series consists of deep, well drained, moderately permeable soils on uplands and high stream benches. These soils formed in loess. The slopes range from 2 to 9 percent.

Typical pedon of Wakenda silt loam, 2 to 5 percent slopes, 2,175 feet south and 150 feet east of the northwest corner of sec. 21, T. 53 N., R. 21 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; moderate fine granular structure; very friable; common fine roots; slightly acid; abrupt smooth boundary.

A—6 to 14 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak very fine subangular blocky structure parting to moderate very fine granular; very friable; common fine roots; slightly acid; clear smooth boundary.

BA—14 to 20 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark brown (10YR 3/3) crushed, dark grayish brown (10YR 4/2) dry; moderate very fine subangular blocky structure; friable; few fine roots; slightly acid; clear smooth boundary.

Bt1—20 to 31 inches; brown (10YR 4/3) silty clay loam; moderate very fine subangular blocky structure; firm; few fine roots; very dark grayish brown (10YR 3/2) coatings and common distinct clay films on faces of peds; slightly acid; gradual smooth boundary.

Bt2—31 to 42 inches; brown (10YR 4/3) silty clay loam; moderate fine subangular blocky structure; firm; few fine roots; very dark grayish brown (10YR 3/2) coatings on faces of some peds; common distinct clay films on faces of peds; slightly acid; clear smooth boundary.

BC—42 to 51 inches; brown (10YR 4/3) silty clay loam; common fine distinct dark yellowish brown (10YR 4/6) and common fine faint dark yellowish brown (10YR 4/4) and grayish brown (10YR 5/2) mottles; weak fine subangular blocky structure; friable; few fine roots; few faint clay films on some vertical faces of peds; slightly acid; gradual smooth boundary.

C—51 to 60 inches; brown (10YR 4/3) silt loam; common fine faint grayish brown (10YR 5/2), brown (10YR 5/3), and dark yellowish brown (10YR 4/4) mottles; massive; friable; very few fine roots; common silt coatings on faces of peds; slightly acid.

The mollic epipedon is 16 to 24 inches thick. The A horizon has value of 2 or 3 and chroma of 1 or 2. The upper part of the Bt horizon has chroma of 2 or 3. The lower part has value of 4 or 5 and chroma of 3 or 4. The C horizon, if it occurs, has value of 4 or 5 and chroma of 3 or 4. It is silt loam or clay loam.

Waldron Series

The Waldron series consists of deep, somewhat poorly drained, slowly permeable soils on flood plains along the Missouri River. These soils formed in calcareous, stratified deposits of clayey and silty alluvium. The slopes range from 0 to 2 percent.

Typical pedon of Waldron silty clay loam, 250 feet south and 1,750 feet west of the northeast corner of sec. 21, T. 51 N., R. 25 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; mixed with very dark gray (10YR 3/1) streaks and pockets of silty clay substratum material; friable; few fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

C—8 to 16 inches; very dark gray (10YR 3/1) silty clay; few fine distinct brown (10YR 4/3) mottles; weak very fine subangular blocky structure; firm; few thin strata of dark grayish brown (10YR 4/2) very fine sandy loam; dark yellowish brown stains on faces of peds; slight effervescence; mildly alkaline; clear smooth boundary.

Cg1—16 to 31 inches; very dark grayish brown (10YR 3/2) silty clay; common fine faint brown (10YR 4/3) mottles; weak fine angular blocky structure; firm; very dark gray (10YR 3/1) organic coatings on faces of peds; common thin strata of dark gray (10YR 4/1) and dark grayish brown (10YR 4/2) very fine sandy loam; dark yellowish brown stains in old root channels; slight effervescence; moderately alkaline; clear smooth boundary.

Cg2—31 to 36 inches; very dark grayish brown (10YR 3/2) silty clay loam; few fine faint brown (10YR 4/3) mottles; massive; firm; slight effervescence; moderately alkaline; clear smooth boundary.

Cg3—36 to 60 inches; very dark grayish brown (10YR 3/2) silty clay loam; common fine faint brown (10YR 4/3) mottles; massive; firm; many thin strata of dark grayish brown (10YR 4/2) and brown (10YR 4/3)

very fine sandy loam; slight effervescence; mildly alkaline.

Free carbonates are within a depth of 10 inches. The content of clay in the 10- to 40-inch control section ranges from 35 to 50 percent. Thin lenses of coarser textured material are in the control section.

The Ap or A horizon has value of 2 or 3 and chroma of 1 or 2. The C horizon has hue of 10YR or 2.5Y, value of 2 to 5, and chroma of 1 to 3.

Waubonsie Series

The Waubonsie series consists of deep, somewhat poorly drained soils along the Missouri River. Permeability is moderately rapid in the upper part and slow in the lower part. These soils formed in calcareous, loamy alluvium over calcareous, clayey alluvium underlain by calcareous, stratified alluvium. The slopes range from 0 to 2 percent.

Typical pedon of Waubonsie fine sandy loam, loamy substratum, 80 feet south and 310 feet east of the northwest corner of sec. 16, T. 53 N., R. 20 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark brown (10YR 3/3) crushed, grayish brown (10YR 5/2) dry; weak fine granular structure; very friable; few fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

C—7 to 20 inches; dark grayish brown (10YR 4/2) fine sandy loam; few fine distinct dark yellowish brown (10YR 4/4) mottles; massive; very friable; common thin strata of dark brown (10YR 3/3) and 3-inch strata of dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) very fine sandy loam and silt loam at a depth of about 17 inches; few fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

2Ab1—20 to 23 inches; very dark grayish brown (10YR 3/2) silty clay loam; few fine faint dark grayish brown (10YR 4/2) and common fine faint brown (10YR 4/3) mottles; weak fine subangular blocky structure parting to moderate fine granular; friable; common fine red (2.5YR 4/8) organic stains; few fine black stains; slight effervescence; mildly alkaline; abrupt smooth boundary.

2Ab2—23 to 30 inches; very dark gray (10YR 3/1) silty clay; common fine faint dark grayish brown (10YR 4/2) and common fine distinct brown (10YR 4/3) mottles; moderate fine prismatic structure parting to moderate very fine angular blocky; firm; slight effervescence; mildly alkaline; abrupt smooth boundary.

2Bgb—30 to 36 inches; dark grayish brown (2.5Y 4/2) silty clay; many fine distinct light olive brown (2.5Y 5/4) and few fine prominent yellowish brown (10YR 5/6) mottles; weak fine prismatic structure parting to moderate very fine angular blocky; firm; common fine red (2.5YR 4/8) organic stains; slight effervescence; mildly alkaline; clear smooth boundary.

2Cg—36 to 60 inches; stratified dark grayish brown (2.5Y 4/2) silty clay loam and dark grayish brown (10YR 4/2) and brown (10YR 4/3) silt loam and very fine sandy loam; few medium prominent yellowish brown (10YR 5/6) and many fine and medium distinct brown (10YR 4/3) and dark yellowish brown (10YR 4/4) mottles; massive; friable; few thin strata of dark grayish brown (10YR 4/2) fine sandy loam; slight effervescence; mildly alkaline.

The upper part of the loamy alluvium is 18 to 30 inches thick. The soils have free carbonates throughout.

The Ap horizon is less than 10 inches thick. It has value of 3 or 4. The C horizon has value of 4 or 5. It is fine sandy loam or very fine sandy loam. Most pedons have thin strata of other textures. Mottles have hue of 7.5YR to 2.5Y, value of 3 to 5, and chroma of 3 to 6. The 2Ab horizon has hue of 10YR or 2.5Y and value of 2 or 3. It averages more than 35 percent clay. The 2Bg horizon has hue of 10YR or 2.5Y and value of 4 or 5. It is silty clay loam or silty clay and averages more than 35 percent clay. The 2Cg horizon has colors similar to those of the 2Bg horizon. It is silty clay loam, silt loam, loam, or very fine sandy loam.

Zook Series

The Zook series consists of deep, poorly drained, slowly permeable soils on flood plains along tributaries of the Missouri River. These soils formed in silty and clayey alluvium. The slopes range from 0 to 2 percent.

Typical pedon of Zook silty clay loam, 600 feet west and 1,500 feet south of the northeast corner of sec. 9, T. 53 N., R. 21 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; moderate fine granular structure; firm; many fine roots; slightly acid; abrupt smooth boundary.

A1—8 to 14 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate very fine subangular blocky structure; firm; few fine roots; medium acid; clear smooth boundary.

A2—14 to 23 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; moderate very fine subangular blocky structure; firm; few fine

roots; medium acid; clear smooth boundary.

A3—23 to 42 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; firm; few fine roots; medium acid; clear smooth boundary.

A4—42 to 48 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 5/1) dry; few fine distinct brown (10YR 4/3) mottles; weak very fine subangular blocky structure; firm; few fine roots; slightly acid; gradual smooth boundary.

Bg—48 to 60 inches; dark gray (10YR 4/1) silty clay; common fine faint dark grayish brown (10YR 4/2) mottles; weak very fine subangular blocky structure; firm; neutral.

The content of clay in the solum ranges from 32 to 45 percent. The mollic epipedon is more than 36 inches thick.

The A horizon has value of 2 or 3. The Bg horizon and Cg horizon, if it occurs, have hue of 10YR or 2.5Y and value of 2 to 4. Mottles with higher value and chroma are below a depth of 36 inches.

Formation of the Soils

Soil forms through processes that act on accumulated or deposited geologic material. The characteristics of the soil are determined by the type of parent material; the plant and animal life on and in the soil; the climate under which the soil material accumulated; the topography, or lay of the land; and the length of time that these forces of soil formation have been active.

Parent material affects the kind of soil profile that forms and, in extreme cases, determines it almost entirely. Climate determines the amount of water available for leaching and the amount of heat available for physical and chemical changes. Together, climate and plant and animal life act on the parent material that has accumulated and slowly change it into a natural body that has genetically related horizons. Relief modifies the effects of climate and plant and animal life. Finally, time is needed for the transformation of the parent material into a soil. Generally, a long time is required for the development of distinct soil horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made about the effect of any one factor unless conditions are specified about the other four.

Parent Material

Parent material is the unconsolidated mass in which a soil forms. The formation or deposition of this material is the first step in the development of a soil profile. The characteristics of the material determine the chemical and mineralogical composition of the soil. The soils in Carroll County formed in four kinds of parent material, alone or in combination. These are residual material weathered from bedrock; glacial material; loess, or wind-deposited material; and alluvium, or water-deposited material.

Gosport, Greenton, and Sampsel soils developed in material weathered from shale interbedded with thin layers of limestone. Sampsel soils also have a thin loess cap over the residual material.

Glacial material was transported by glaciation. It is made up of clay, silt, sand, gravel, and a few boulders. Much of the glacial material was moved a long distance, but some is of local origin. Armster soils formed in glacial till, and Lagonda soils formed in glacial material with a thin loess cap.

Loess is silty material transported by wind. It is an extensive parent material in Carroll County. Its principal source probably is the flood plains of the Missouri River, which formed after the retreat of the last glacier. The deepest deposits of loess are on the hills that border these flood plains. The well drained Knox and Wakenda soils formed in this loess. Further from the flood plains, the deposits are thinner and contain more clay. Soils that have more restricted drainage formed in finer textured parent material on gentle slopes. Grundy, Ladoga, and Sharpsburg soils are examples.

Alluvium is material that was transported by water and deposited on nearly level flood plains. Its origins are diverse, and the flowing water that carried the material varied in speed. As a result, this material varies widely in texture and mineralogical composition. The source of parent material for soils on flood plains along small tributary streams is limited to material from local uplands. The coarser Nodaway soils formed in material deposited near the stream channels where the current was strongest. The finer textured Wabash and Zook soils formed further from the stream channels where the finer clay particles from the backwaters settled. The vast drainage area of the Missouri River provides parent material for soils on the adjacent flood plains. As a result, the soils on the Missouri River flood plains have a wide range of soil textures. Their differences reflect the varying speeds of the flowing water. The parent material of the coarser Haynie, Landes, and Norborne soils was deposited by water that had sufficient flow and velocity to carry sand-sized particles. The parent material of the heavier Aholt, Booker, Leta, and Waldron soils was deposited in areas of slack water.

Plant and Animal Life

Plants and animals living on or in the soil are active in the process of soil formation. Plants furnish organic matter to the soil and bring plant nutrients from

underlying layers to the surface layer. As plants die and decay, they contribute organic matter to the soil. Bacteria and fungi decompose the plant remains and help to incorporate the organic matter into the soil.

Native prairie grasses and trees have greatly influenced soil formation in Carroll County. Soils that form under prairie grasses accumulate organic matter mainly through the yearly decomposition of plant material. The tops of plants decompose at the surface, and the roots decompose at various depths in the soil. As a result, soils that formed under prairie grasses have a thick, dark surface layer. Grundy, Sharpsburg, and Wakenda are examples of prairie soils.

Soils that form under forest vegetation accumulate organic matter mainly through the decomposition of leaves and twigs on the surface. As a result, forest soils have a thin, dark surface layer. Armster, Knox, and Ladoga soils are examples.

Insects, worms, and animals affect soil formation. Bacteria and fungi contribute more to soil formation than animals. They cause organic material to rot, fix nitrogen, and improve tilth. Burrowing animals and insects loosen and mix the various soil horizons.

In a short time human activities have greatly affected soil formation in Carroll County. They have caused changes in vegetation and drainage and have accelerated erosion. Row crops have replaced native grasses and many forested areas. Nearly all of the flood plains and many of the upland areas are farmed. Food production has increased, but accelerated erosion continues to reduce the potential of many upland soils and the loss of cropland to urban development is virtually irreversible.

Climate

Climate is an important factor in soil formation. Geologic erosion, recent accelerated erosion, and plant and animal life have varied with the climate. Present climatic conditions tend to favor the growth of forests rather than prairie grasses. The areas of prairie that existed in Carroll County were the result of a more arid climatic cycle.

The glacial periods that so greatly affected the processes of soil formation were the result of climatic changes. Thousands of years of cold temperatures resulted in the formation of glaciers that moved into the survey area. Warmer weather and high winds caused severe geologic erosion, and much of the area was covered by loess.

High temperatures and adequate rainfall promote rapid chemical and physical changes. A climate with these characteristics is conducive to the breakdown of minerals and the relocation of clay within the soil. The clay is moved downward in the soil profile, or eluviated, forming a clayey subsoil. Nearly all the upland soils show evidence of this eluviation.

Topography

Topography, or lay of the land, affects soil formation through its influence on drainage, runoff, infiltration, and accelerated erosion. Topography is characterized by the length, shape, aspect, and steepness of landforms. It is important in determining the pattern and distribution of the soils.

The amount of water that enters the soil depends on the slope, permeability, and the intensity of rainfall. On steep slopes, runoff is rapid, very little water passes through the soil, and soil formation is slow. Geologic erosion almost keeps pace with the processes of soil formation. In gently sloping areas, runoff is slow, erosion is minimal, and most of the water passes through the soil. In these areas, leaching, the translocation of clay, and other soil-forming processes are intensified and the soil has maximum profile development.

Steep, south-facing slopes receive more direct sunrays and are more droughty than north-facing slopes. Droughtiness influences soil formation through its effect on the kinds of vegetation, erosion, and freezing and thawing.

Time

The degree of profile development depends on the length of time that the parent material has been in place and subject to the soil-forming processes. The age of a soil is determined by the degree of profile development. It is a result of the interaction of the soil-forming processes over a period of time and not just the years the material has existed. The older soils show the effects of leaching and clay movement and have distinct horizons. Young soils show little profile development.

The youngest soils in Carroll County are alluvial. Nodaway soils have no profile development because they receive alluvial material nearly every year. The Bremer and Cotter soils on stream terraces are older alluvial soils and have distinct profile development.

The steep, shallow soils, such as Gosport soils, formed in shale and limestone that are much older than the parent material of other soils. The removal of material through geological erosion, however, nearly keeps pace with the soil-forming processes. Thus, these soils are considered young.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly, such soil formed in recent alluvium or on steep, rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation-exchange capacity.

Bedding system. A drainage system made by plowing, grading, or otherwise shaping the surface of a flat field. It consists of a series of low ridges separated by shallow, parallel dead furrows.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a channer.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in

diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops

unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, or clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of the material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to

be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are:

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by the wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedisediment. A thin layer of alluvial material that mantles an erosion surface and has been transported to its present position from higher areas of the erosion surface.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range in moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 drawbar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and

other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. In this survey the following slope classes are recognized:

Nearly level	0 to 2 percent
Gently sloping	2 to 5 percent
Moderately sloping	5 to 9 percent
Strongly sloping	9 to 14 percent
Moderately steep	14 to 20 percent
Steep	20 to 30 percent

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time. The classes used in this survey to refer to the depth of the soil to bedrock are defined as follows:

Very shallow	less than 10 inches
Shallow	10 to 20 inches
Moderately deep	20 to 40 inches
Deep	more than 40 inches

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the substratum. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of coarse fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediments of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind erosion and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind erosion and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Breaking up a compact subsoil by pulling a special chisel through the soil.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It

includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material that is too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1951-86 at Marshall, Missouri)

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days*	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January-----	38.1	18.0	28.1	67	-12	8	1.31	0.28	2.11	3	3.8
February----	43.5	23.5	33.5	71	-4	11	1.50	.59	2.25	4	4.1
March-------	54.6	32.1	43.4	83	5	95	2.93	1.27	4.33	6	1.3
April-------	68.6	44.6	56.6	89	23	227	3.82	1.99	5.42	7	.3
May---------	77.6	54.6	66.1	92	36	499	4.37	2.77	5.81	7	.0
June--------	86.0	63.5	74.8	97	46	744	4.17	1.85	6.14	7	.0
July--------	91.1	67.8	79.5	103	53	915	4.00	1.64	5.98	6	.0
August------	89.0	65.1	77.1	101	51	840	2.90	1.10	4.40	5	.0
September---	81.6	57.5	69.6	96	39	588	4.10	1.18	6.44	5	.0
October-----	70.8	46.7	58.8	90	26	292	3.33	1.07	5.18	5	.0
November----	54.8	33.9	44.4	77	10	47	2.12	.46	3.45	3	.9
December----	42.5	24.1	33.3	67	-5	11	1.58	.57	2.41	4	3.4
Yearly:											
Average---	66.5	44.3	55.4	---	---	---	---	---	---	---	---
Extreme---	---	---	---	104	-14	---	---	---	---	---	---
Total-----	---	---	---	---	---	4,277	36.13	29.18	45.65	62	13.8

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1951-86 at Marshall, Missouri)

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	Apr. 9	Apr. 20	Apr. 29
2 years in 10 later than--	Apr. 4	Apr. 15	Apr. 24
5 years in 10 later than--	Mar. 25	Apr. 5	Apr. 14
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 24	Oct. 18	Oct. 4
2 years in 10 earlier than--	Oct. 30	Oct. 23	Oct. 9
5 years in 10 earlier than--	Nov. 10	Nov. 1	Oct. 20

TABLE 3.--GROWING SEASON

(Recorded in the period 1951-86 at Marshall, Missouri)

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
9 years in 10	204	187	168
8 years in 10	213	195	175
5 years in 10	229	209	189
2 years in 10	245	224	202
1 year in 10	253	231	209

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
01B	Lagonda silt loam, 2 to 5 percent slopes	25,200	5.6
02C2	Lagonda silty clay loam, 5 to 9 percent slopes, eroded	62,500	13.9
03B	Armster loam, 2 to 5 percent slopes	400	0.1
03C	Armster loam, 5 to 9 percent slopes	29,400	6.6
04C2	Armster clay loam, 5 to 9 percent slopes, eroded	5,000	1.1
04D3	Armster clay loam, 9 to 14 percent slopes, severely eroded	3,000	0.7
05B	Grundy silt loam, 2 to 5 percent slopes	24,400	5.4
07C2	Knox silt loam, 5 to 9 percent slopes, eroded	7,200	1.6
07E2	Knox silt loam, 14 to 20 percent slopes, eroded	1,300	0.3
07F	Knox silt loam, 20 to 30 percent slopes	2,000	0.5
08D3	Knox silty clay loam, 9 to 14 percent slopes, severely eroded	3,750	0.8
09B	Sharpsburg silt loam, 2 to 5 percent slopes	12,200	2.7
09C2	Sharpsburg silt loam, 5 to 9 percent slopes, eroded	2,600	0.6
11B	Ladoga silt loam, 2 to 5 percent slopes	1,390	0.3
11C2	Ladoga silt loam, 5 to 9 percent slopes, eroded	2,650	0.6
14C2	Greenton silty clay loam, 5 to 9 percent slopes, eroded	34,800	7.8
14D2	Greenton silty clay loam, 9 to 14 percent slopes, eroded	3,850	0.9
16B	Sampsel silty clay loam, 2 to 5 percent slopes	650	0.2
21B	Wakenda silt loam, 2 to 5 percent slopes	7,250	1.6
21C2	Wakenda silt loam, 5 to 9 percent slopes, eroded	4,900	1.1
23C2	Higginsville silt loam, 5 to 9 percent slopes, eroded	7,250	1.6
25C	Gosport silty clay loam, 5 to 9 percent slopes	2,250	0.5
25D	Gosport silty clay loam, 9 to 14 percent slopes	14,000	3.1
25F	Gosport silty clay loam, 14 to 30 percent slopes	12,200	2.7
30	Nodaway silt loam	28,750	6.4
32	Colo silty clay loam	15,700	3.5
34	Zook silty clay loam	8,500	1.9
36	Wabash silty clay	6,930	1.5
42	Bremer silt loam, occasionally flooded	1,800	0.4
60	Aholt silty clay	1,700	0.4
62	Booker silty clay	10,000	2.2
64	Cotter silt loam	17,000	3.8
66	Gilliam silt loam	6,100	1.4
68	Haynie very fine sandy loam	11,400	2.5
70	Hodge loamy fine sand	680	0.2
72	Kenmoor loamy fine sand	300	0.1
74	Landes fine sandy loam	930	0.2
76	Leta silty clay	13,100	2.9
84	Norborne loam	2,900	0.6
86	Parkville silty clay loam	4,500	1.0
88	Bremer silty clay loam, rarely flooded	27,550	6.1
90	Waldron silty clay loam	11,000	2.4
92	Waubonsie fine sandy loam, loamy substratum	3,325	0.7
100	Udorthents, nearly level to strongly sloping	55	*
	Water areas less than 40 acres in size	1,300	0.3
	Water areas more than 40 acres in size	5,332	1.2
	Total	448,992	100.0

* Less than 0.05 percent.

TABLE 5.--PRIME FARMLAND

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name)

Map symbol	Soil name
01B	Lagonda silt loam, 2 to 5 percent slopes
03B	Armster loam, 2 to 5 percent slopes
05B	Grundy silt loam, 2 to 5 percent slopes
09B	Sharpsburg silt loam, 2 to 5 percent slopes
11B	Ladoga silt loam, 2 to 5 percent slopes
16B	Sampsel silty clay loam, 2 to 5 percent slopes (where drained)
21B	Wakenda silt loam, 2 to 5 percent slopes
30	Nodaway silt loam (where protected from flooding or not frequently flooded during the growing season)
32	Colo silty clay loam (where drained)
34	Zook silty clay loam (where drained)
36	Wabash silty clay (where drained)
42	Bremer silt loam, occasionally flooded (where drained)
60	Aholt silty clay (where drained)
62	Booker silty clay (where drained)
64	Cotter silt loam
66	Gilliam silt loam
68	Haynie very fine sandy loam
74	Landes fine sandy loam
76	Leta silty clay
84	Norborne loam
86	Parkville silty clay loam
88	Bremer silty clay loam, rarely flooded (where drained)
90	Waldron silty clay loam (where drained)
92	Waubonsie fine sandy loam, loamy substratum

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE

(Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability	Corn	Soybeans	Grain sorghum	Winter wheat	Orchard-grass-red clover hay	Tall fescue	Switchgrass
		Bu	Bu	Bu	Bu	Tons	AUM*	AUM*
01B------------- Lagonda	IIe	102	38	89	42	3.8	5.6	5.6
02C2------------ Lagonda	IIIe	89	33	77	36	3.3	4.9	4.9
03B------------- Armster	IIe	102	38	88	41	3.8	5.6	5.6
03C------------- Armster	IIIe	94	35	83	38	3.6	5.3	5.3
04C2------------ Armster	IIIe	89	33	78	36	3.3	4.9	4.9
04D3------------ Armster	VIe	---	---	---	---	2.7	4.0	4.0
05B------------- Grundy	IIe	102	38	89	42	3.8	5.6	5.6
07C2------------ Knox	IIIe	100	37	87	41	3.7	5.4	5.4
07E2------------ Knox	IVe	79	28	70	32	2.9	4.4	4.4
07F------------- Knox	VIe	---	---	---	---	2.5	4.3	4.3
08D3------------ Knox	IVe	82	30	72	33	3.1	4.6	4.6
09B------------- Sharpsburg	IIe	118	44	104	48	4.4	6.6	6.6
09C2------------ Sharpsburg	IIIe	105	39	91	43	3.9	5.8	5.8
11B------------- Ladoga	IIe	113	41	98	46	4.2	6.3	6.3
11C2------------ Ladoga	IIIe	99	36	86	40	3.7	5.4	5.4
14C2------------ Greenton	IIIe	89	32	78	36	3.3	4.9	4.9
14D2------------ Greenton	VIe	---	---	---	---	2.9	4.3	4.3
16B------------- Sampsel	IIe	97	36	85	40	3.6	5.4	5.4
21B------------- Wakenda	IIe	126	45	110	51	4.7	7.0	7.0

See footnote at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Grain sorghum	Winter wheat	Orchardgrass-red clover hay	Tall fescue	Switchgrass
		Bu	Bu	Bu	Bu	Tons	AUM*	AUM*
21C2------------ Wakenda	IIIe	114	40	98	46	4.2	6.3	6.3
23C2------------ Higginsville	IIIe	116	42	101	47	4.3	6.5	6.5
25C------------- Gosport	IVe	65	23	56	26	2.4	3.6	3.6
25D------------- Gosport	VIe	---	---	---	---	---	3.0	3.0
25F------------- Gosport	VIIe	---	---	---	---	---	2.1	2.1
30-------------- Nodaway	IIIw	100	37	87	40	3.7	5.5	5.5
32-------------- Colo	IIw	114	41	99	46	4.2	6.3	6.3
34-------------- Zook	IIw	87	31	76	35	3.2	4.8	4.8
36-------------- Wabash	IIIw	81	30	71	33	3.0	4.5	4.5
42-------------- Bremer	IIw	102	38	89	42	3.8	5.6	5.6
60-------------- Aholt	IIIw	54	21	47	22	2.0	3.0	3.0
62-------------- Booker	IIIw	75	28	66	30	2.8	4.2	4.2
64-------------- Cotter	I	122	45	110	50	4.6	6.9	6.9
66-------------- Gilliam	IIw	121	45	108	49	4.6	6.9	6.9
68-------------- Haynie	IIw	108	40	94	44	4.0	6.0	6.0
70-------------- Hodge	IIIs	54	20	47	22	2.0	3.0	3.0
72-------------- Kenmoor	IIIs	67	25	59	27	2.5	3.8	3.8
74-------------- Landes	IIw	79	29	69	32	2.9	4.4	4.4
76-------------- Leta	IIw	97	35	83	40	3.6	5.4	5.4
84-------------- Norborne	I	110	41	96	45	4.1	6.2	6.2

See footnote at end of table.

TABLE 6.--LAND CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Grain sorghum	Winter wheat	Orchard-grass-red clover hay	Tall fescue	Switchgrass
		Bu	Bu	Bu	Bu	Tons	AUM*	AUM*
86-------------- Parkville	IIw	97	36	85	40	3.6	5.4	5.4
88-------------- Bremer	IIw	114	41	99	46	4.2	6.3	6.3
90-------------- Waldron	IIw	87	30	74	37	3.1	4.7	4.7
92-------------- Waubonsie	IIs	87	31	76	35	3.2	4.8	4.8
100. Udorthents								

* Animal unit month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY

(Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available)

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
03B, 03C, 04C2, 04D3 Armster	4A	Slight	Slight	Slight	Slight	Pin oak White oak Northern red oak	70 57 ---	52 40 ---	Pin oak, white ash, northern red oak, white oak, black oak.
07C2 Knox	4A	Slight	Slight	Slight	Slight	White oak Northern red oak Black oak	69 78 74	48 60 56	White ash, black walnut, white oak.
07E2, 07F Knox	4R	Moderate	Moderate	Moderate	Slight	White oak Northern red oak Black oak	69 78 74	48 60 56	White oak, white ash, black walnut.
08D3 Knox	4A	Slight	Slight	Slight	Slight	White oak Northern red oak Black oak	69 78 74	57 57 56	White oak, white ash, black walnut.
11B, 11C2 Ladoga	4A	Slight	Slight	Slight	Slight	White oak Northern red oak	75 75	57 57	White oak, northern red oak, black walnut.
25C, 25D Gosport	2C	Slight	Slight	Severe	Severe	White oak Black oak	45 ---	30 ---	Eastern white pine, black oak.
25F Gosport	2R	Moderate	Moderate	Severe	Severe	White oak	45	30	Eastern white pine, black oak.
30 Nodaway	3A	Slight	Slight	Slight	Slight	Eastern cottonwood American sycamore Pecan	100 --- ---	128 --- ---	Black walnut, eastern cottonwood, American sycamore, green ash, white oak.
42 Bremer	7W	Slight	Severe	Moderate	Moderate	Eastern cottonwood Silver maple	90 80	103 34	Eastern cottonwood, American sycamore, hackberry, green ash.
60 Aholt	7W	Slight	Moderate	Severe	Severe	Eastern cottonwood Pin oak	90 80	103 62	Pin oak, green ash, eastern cottonwood.

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordi- nation symbol	Management concerns: Erosion hazard	Management concerns: Equip- ment limita- tion	Management concerns: Seedling mortal- ity	Management concerns: Wind- throw hazard	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Volume*	Trees to plant
62-------------- Booker	6W	Slight	Severe	Severe	Severe	Eastern cottonwood-- Silver maple--------	85 80	91 34	Eastern cottonwood, pin oak, pecan, green ash.
64-------------- Cotter	9A	Slight	Slight	Slight	Slight	Eastern cottonwood--	100	128	Eastern cottonwood, black walnut.
66-------------- Gilliam	8A	Slight	Slight	Slight	Slight	Eastern cottonwood-- Pin oak-------------	95 80	116 62	Pin oak, eastern cottonwood, pecan.
68-------------- Haynie	11A	Slight	Slight	Slight	Slight	Eastern cottonwood-- American sycamore--- Black walnut-------- Green ash-----------	110 110 --- ---	156 157 --- ---	Black walnut, eastern cottonwood.
70-------------- Hodge	11S	Slight	Slight	Moderate	Slight	Eastern cottonwood-- Silver maple--------	110 105	156 56	Eastern cottonwood, green ash.
72-------------- Kenmoor	6S	Slight	Slight	Moderate	Slight	Eastern cottonwood-- Pin oak------------- Green ash-----------	85 75 60	91 57 51	Eastern cottonwood, pin oak, green ash.
74-------------- Landes	10A	Slight	Slight	Slight	Slight	Eastern cottonwood-- American sycamore--- Green ash-----------	105 --- ---	141 --- ---	Eastern cottonwood, American sycamore, green ash, black walnut.
76-------------- Leta	7W	Slight	Moderate	Severe	Severe	Eastern cottonwood--	90	103	Pecan, eastern cottonwood, green ash.
84-------------- Norborne	5A	Slight	Slight	Slight	Slight	Pin oak------------- Pecan---------------	90 75	72 ---	Pin oak, pecan, green ash, eastern cottonwood.
86-------------- Parkville	9C	Slight	Moderate	Severe	Slight	Eastern cottonwood-- Pin oak-------------	100 90	128 72	Eastern cottonwood, pin oak, pecan, American sycamore.
88-------------- Bremer	7W	Slight	Severe	Moderate	Moderate	Silver maple-------- Eastern cottonwood--	80 90	2 7	Eastern cottonwood, American sycamore, hackberry, green ash.

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential productivity: Common trees	Site index	Volume*	Trees to plant
90-------------- Waldron	11C	Slight	Moderate	Severe	Slight	Eastern cottonwood-- Pin oak-------------	110 80	156 62	Pin oak, pecan, eastern cottonwood, green ash.

* Volume is the yield in cubic feet per acre per year calculated at the age of culmination of mean annual increment for fully stocked natural stands.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
01B, 02C2: Lagonda	---	Amur honeysuckle, Washington hawthorn, Amur privet, arrowwood, eastern redcedar, American cranberrybush.	Austrian pine, Osageorange, green ash.	Pin oak, eastern white pine.	---
03B, 03C, 04C2, 04D3: Armster	---	Amur honeysuckle, Amur privet, silky dogwood, American cranberrybush.	White fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce, Austrian pine.	Eastern white pine, pin oak.
05B: Grundy	---	Washington hawthorn, eastern redcedar, Amur honeysuckle, Amur privet, American cranberrybush, arrowwood.	Austrian pine, Osageorange, green ash.	Pin oak, eastern white pine.	---
07C2, 07E2, 07F, 08D3: Knox	---	Amur honeysuckle, lilac, Amur maple.	Hackberry, eastern redcedar, green ash, bur oak, Russian-olive.	Austrian pine, eastern white pine, honeylocust.	---
09B, 09C2: Sharpsburg	---	Silky dogwood, Amur honeysuckle, American cranberrybush, Amur privet.	White fir, blue spruce, northern whitecedar, Washington hawthorn.	Austrian pine, Norway spruce.	Eastern white pine, pin oak.
11B, 11C2: Ladoga	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	White fir, blue spruce, northern whitecedar, Washington hawthorn.	Austrian pine, Norway spruce.	Eastern white pine, pin oak.
14C2, 14D2: Greenton	---	Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, Amur honeysuckle, American cranberrybush.	Austrian pine, green ash, Osageorange.	Eastern white pine, pin oak.	---
16B: Sampsel	---	Eastern redcedar, arrowwood, Amur honeysuckle, Amur privet, Washington hawthorn, American cranberrybush.	Austrian pine, Osageorange, green ash.	Pin oak, eastern white pine.	---

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
21B, 21C2 Wakenda	---	Amur maple, lilac	Amur honeysuckle, eastern redcedar, bur oak, hackberry, green ash, Russian-olive.	Austrian pine, eastern white pine, honeylocust.	---
23C2 Higginsville	---	Amur honeysuckle, lilac, Amur maple.	Eastern redcedar	Austrian pine, eastern white pine, honeylocust, hackberry, green ash, pin oak.	Eastern cottonwood.
25C, 25D, 25F Gosport	---	Eastern redcedar, Washington hawthorn, Amur privet, arrowwood, Amur honeysuckle, American cranberrybush.	Austrian pine, green ash, Osageorange.	Eastern white pine, pin oak.	---
30 Nodaway	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Austrian pine, white fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce	Eastern white pine, pin oak.
32 Colo	---	Amur privet, Amur honeysuckle, American cranberrybush, silky dogwood.	Norway spruce, Austrian pine, blue spruce, white fir, northern whitecedar, Washington hawthorn.	Eastern white pine	Pin oak.
34 Zook	---	Silky dogwood, Amur honeysuckle, American cranberrybush, Amur privet.	Norway spruce, northern whitecedar, Austrian pine, blue spruce, white fir, Washington hawthorn.	Eastern white pine	Pin oak.
36 Wabash	Redosier dogwood	American plum, common chokecherry.	Eastern redcedar, hackberry.	Austrian pine, green ash, northern red oak, golden willow, honeylocust, silver maple.	Eastern cottonwood.
42 Bremer	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	Norway spruce, Austrian pine, blue spruce, white fir, northern whitecedar, Washington hawthorn.	Eastern white pine	Pin oak.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
60 Aholt	---	American plum, fragrant sumac, common chokecherry.	Manchurian crabapple, eastern redcedar, hackberry.	Austrian pine, Russian mulberry, green ash, golden willow, honeylocust.	Eastern cottonwood.
62 Booker	Redosier dogwood	American plum, common chokecherry.	Eastern redcedar, hackberry.	Austrian pine, honeylocust, green ash, silver maple, golden willow, northern red oak.	Eastern cottonwood.
64 Cotter	---	Amur maple, lilac, Amur honeysuckle.	Green ash, hackberry, bur oak, eastern redcedar, Russian-olive.	Eastern white pine, Austrian pine, honeylocust.	---
66 Gilliam	Blackhaw	Siberian peashrub	Osageorange, Washington hawthorn, eastern redcedar, Russian-olive.	Honeylocust, hackberry, bur oak, green ash.	Eastern cottonwood.
68 Haynie	Blackhaw	Siberian peashrub	Washington hawthorn, Russian-olive, Osageorange, eastern redcedar.	Bur oak, hackberry, green ash, honeylocust.	Eastern cottonwood.
70 Hodge	Blackhaw	Siberian peashrub	Eastern redcedar, Russian-olive, Osageorange, Washington hawthorn.	Honeylocust, hackberry, green ash, bur oak.	Eastern cottonwood.
72 Kenmoor	Blackhaw	Siberian peashrub	Eastern redcedar, Osageorange, Russian-olive, Washington hawthorn.	Honeylocust, hackberry, green ash, bur oak.	Eastern cottonwood.
74 Landes	---	Silky dogwood, Amur privet, Amur honeysuckle, American cranberrybush.	Austrian pine, white fir, blue spruce, northern whitecedar, Washington hawthorn.	Norway spruce	Eastern white pine, pin oak.
76 Leta	Blackhaw	Siberian peashrub	Eastern redcedar, Osageorange, Russian-olive, Washington hawthorn.	Honeylocust, hackberry, green ash, bur oak.	Eastern cottonwood.
84 Norborne	---	Amur honeysuckle, Amur maple, lilac.	Eastern redcedar	Honeylocust, pin oak, eastern white pine, Austrian pine, hackberry, green ash.	Eastern cottonwood.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
86----------------- Parkville	Blackhaw----------	Siberian peashrub	Eastern redcedar, Russian-olive, Osageorange, Washington hawthorn.	Honeylocust, hackberry, green ash, bur oak.	Eastern cottonwood.
88----------------- Bremer	Redosier dogwood	American plum, common chokecherry.	Eastern redcedar, hackberry.	Austrian pine, honeylocust, green ash, silver maple, golden willow, northern red oak.	Eastern cottonwood.
90----------------- Waldron	Blackhaw----------	Siberian peashrub	Eastern redcedar, Russian-olive, Osageorange, Washington hawthorn.	Honeylocust, hackberry, green ash, bur oak.	Eastern cottonwood.
92----------------- Waubonsie	Blackhaw----------	Siberian peashrub	Russian-olive, Osageorange, Washington hawthorn, eastern redcedar.	Bur oak, hackberry, green ash, honeylocust.	Eastern cottonwood.
100. Udorthents					

TABLE 9.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
01B------------------- Lagonda	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Moderate: wetness.	Moderate: wetness.
02C2------------------ Lagonda	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: slope.	Moderate: wetness.	Moderate: wetness.
03B------------------- Armster	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, small stones, percs slowly.	Slight----------	Slight.
03C, 04C2------------- Armster	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Slight----------	Slight.
04D3------------------ Armster	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
05B------------------- Grundy	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Moderate: wetness.	Moderate: wetness.
07C2------------------ Knox	Slight----------	Slight----------	Severe: slope.	Slight----------	Slight.
07E2------------------ Knox	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
07F------------------- Knox	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
08D3------------------ Knox	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
09B------------------- Sharpsburg	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight----------	Slight.
09C2------------------ Sharpsburg	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Slight----------	Slight.
11B------------------- Ladoga	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight----------	Slight.
11C2------------------ Ladoga	Moderate: percs slowly.	Moderate: percs slowly.	Severe: slope.	Slight----------	Slight.
14C2------------------ Greenton	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: slope, wetness.	Moderate: wetness.	Moderate: wetness.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
14D2 Greenton	Severe: wetness.	Moderate: slope, wetness, percs slowly.	Severe: slope, wetness.	Severe: erodes easily.	Moderate: wetness, slope.
16B Sampsel	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, erodes easily.	Severe: wetness.
21B Wakenda	Slight	Slight	Moderate: slope.	Slight	Slight.
21C2 Wakenda	Slight	Slight	Severe: slope.	Slight	Slight.
23C2 Higginsville	Moderate: wetness.	Moderate: wetness.	Severe: slope.	Severe: erodes easily.	Moderate: wetness.
25C Gosport	Severe: percs slowly.	Severe: percs slowly.	Severe: slope, percs slowly.	Severe: erodes easily.	Moderate: depth to rock.
25D Gosport	Severe: percs slowly.	Severe: percs slowly.	Severe: slope, percs slowly.	Severe: erodes easily.	Moderate: slope, depth to rock.
25F Gosport	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: slope, percs slowly.	Severe: erodes easily.	Severe: slope.
30 Nodaway	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.	Severe: flooding.
32 Colo	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
34 Zook	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
36 Wabash	Severe: flooding, wetness, percs slowly.	Severe: wetness, too clayey, percs slowly.	Severe: too clayey, wetness.	Severe: wetness, too clayey.	Severe: wetness, too clayey.
42 Bremer	Severe: flooding, wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
60 Aholt	Severe: flooding, wetness, percs slowly.	Severe: wetness, too clayey, percs slowly.	Severe: too clayey, wetness.	Severe: wetness, too clayey.	Severe: wetness, too clayey.
62 Booker	Severe: flooding, ponding, percs slowly.	Severe: ponding, too clayey, percs slowly.	Severe: too clayey, ponding.	Severe: ponding, too clayey.	Severe: ponding, too clayey.
64 Cotter	Severe: flooding.	Slight	Slight	Slight	Slight.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
66-------------------- Gilliam	Severe: flooding.	Moderate: wetness.	Moderate: wetness, flooding.	Moderate: wetness.	Moderate: wetness, flooding.
68-------------------- Haynie	Severe: flooding.	Slight----------	Moderate: flooding.	Slight----------	Moderate: flooding.
70-------------------- Hodge	Severe: flooding.	Slight----------	Moderate: flooding.	Slight----------	Moderate: droughty, flooding.
72-------------------- Kenmoor	Severe: flooding.	Moderate: percs slowly.	Moderate: flooding, percs slowly.	Slight----------	Moderate: droughty, flooding.
74-------------------- Landes	Severe: flooding.	Slight----------	Slight----------	Slight----------	Moderate: flooding.
76-------------------- Leta	Severe: flooding, wetness, too clayey.	Severe: too clayey.	Severe: too clayey, wetness.	Severe: too clayey.	Severe: too clayey.
84-------------------- Norborne	Severe: flooding.	Slight----------	Slight----------	Slight----------	Slight.
86-------------------- Parkville	Severe: flooding, wetness, percs slowly.	Severe: percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
88-------------------- Bremer	Severe: flooding, wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
90-------------------- Waldron	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, flooding.
92-------------------- Waubonsie	Severe: flooding.	Moderate: wetness, percs slowly.	Moderate: wetness, flooding, percs slowly.	Slight----------	Moderate: flooding.
100. Udorthents					

TABLE 10.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
01B, 02C2 Lagonda	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
03B Armster	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
03C, 04C2, 04D3 Armster	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
05B Grundy	Fair	Good	Fair	Good	Good	Fair	Fair	Fair	Good	Fair.
07C2 Knox	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
07E2 Knox	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
07F Knox	Very poor.	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
08D3 Knox	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
09B Sharpsburg	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
09C2 Sharpsburg	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
11B Ladoga	Good	Good	Fair	Good	Good	Poor	Poor	Good	Good	Poor.
11C2 Ladoga	Fair	Good	Fair	Good	Good	Very poor.	Poor	Fair	Good	Very poor.
14C2 Greenton	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
14D2 Greenton	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
16B Sampsel	Fair	Fair	Fair	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
21B Wakenda	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
21C2 Wakenda	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
23C2 Higginsville	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
25C Gosport	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
25D, 25F----------- Gosport	Very poor.	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
30----------------- Nodaway	Poor	Fair	Fair	Poor	Poor	Good	Fair	Poor	Poor	Fair.
32----------------- Colo	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
34----------------- Zook	Good	Fair	Good	Fair	Poor	Good	Good	Fair	Fair	Good.
36----------------- Wabash	Poor	Poor	Poor	Poor	Poor	Poor	Good	Poor	Poor	Fair.
42----------------- Bremer	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
60----------------- Aholt	Fair	Fair	Fair	Poor	Poor	Good	Good	Fair	Poor	Good.
62----------------- Booker	Poor	Poor	Fair	Poor	Poor	Poor	Good	Poor	Poor	Fair.
64----------------- Cotter	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
66----------------- Gilliam	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
68----------------- Haynie	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
70----------------- Hodge	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
72----------------- Kenmoor	Poor	Fair	Fair	Good	Good	Poor	Fair	Fair	Fair	Poor.
74----------------- Landes	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
76----------------- Leta	Fair	Fair	Poor	Good	Good	Poor	Fair	Fair	Fair	Poor.
84----------------- Norborne	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
86----------------- Parkville	Poor	Fair	Fair	Good	Good	Poor	Fair	Fair	Good	Poor.
88----------------- Bremer	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
90----------------- Waldron	Fair	Fair	Fair	Good	Good	Poor	Fair	Fair	Fair	Poor.
92----------------- Waubonsie	Good	Good	Good	Good	Good	Fair	Good	Good	Good	Good.
100. Udorthents										

TABLE 11.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
01B, 02C2: Lagonda	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness.
03B, 03C, 04C2: Armster	Moderate: too clayey, wetness.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Slight.
04D3: Armster	Moderate: too clayey, wetness, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.	Moderate: slope.
05B: Grundy	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness.
07C2: Knox	Slight	Moderate: shrink-swell.	Slight	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
07E2, 07F: Knox	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope, frost action.	Severe: slope.
08D3: Knox	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
09B: Sharpsburg	Moderate: too clayey, wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
09C2: Sharpsburg	Moderate: too clayey, wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
11B: Ladoga	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
11C2: Ladoga	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
14C2: Greenton	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: low strength, shrink-swell.	Moderate: wetness.
14D2: Greenton	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell, slope.	Severe: low strength, shrink-swell.	Moderate: wetness, slope.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
16B---------------- Sampsel	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.
21B---------------- Wakenda	Moderate: wetness.	Moderate: shrink-swell.	Moderate: shrink-swell, wetness.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
21C2--------------- Wakenda	Moderate: wetness.	Moderate: shrink-swell.	Moderate: shrink-swell, wetness.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.	Slight.
23C2--------------- Higginsville	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell, slope.	Severe: low strength, frost action.	Moderate: wetness.
25C---------------- Gosport	Moderate: depth to rock, too clayey.	Severe: shrink-swell.	Moderate: depth to rock.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Moderate: depth to rock.
25D---------------- Gosport	Moderate: depth to rock, too clayey, slope.	Severe: shrink-swell.	Moderate: depth to rock, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.	Moderate: slope, depth to rock.
25F---------------- Gosport	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength, slope.	Severe: slope.
30----------------- Nodaway	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding, frost action.	Severe: flooding.
32----------------- Colo	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
34----------------- Zook	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness.
36----------------- Wabash	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness, too clayey.
42----------------- Bremer	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, flooding.	Moderate: wetness, flooding.
60----------------- Aholt	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.	Severe: wetness, too clayey.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
62 Booker	Severe: ponding.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding, too clayey.
64 Cotter	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, frost action.	Slight.
66 Gilliam	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: low strength, flooding, frost action.	Moderate: wetness, flooding.
68 Haynie	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding, frost action.	Moderate: flooding.
70 Hodge	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: droughty, flooding.
72 Kenmoor	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding, shrink-swell.	Severe: flooding.	Severe: flooding.	Moderate: droughty, flooding.
74 Landes	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
76 Leta	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, frost action.	Severe: too clayey.
84 Norborne	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding, frost action.	Slight.
86 Parkville	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding.	Moderate: wetness, flooding.
88 Bremer	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength.	Moderate: wetness.
90 Waldron	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, flooding.	Moderate: wetness, flooding.
92 Waubonsie	Severe: wetness.	Severe: flooding, shrink-swell.	Severe: flooding, wetness.	Severe: flooding, shrink-swell.	Severe: shrink-swell, low strength, flooding.	Moderate: flooding.
100. Udorthents						

TABLE 12.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
01B Lagonda	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
02C2 Lagonda	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness, too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
03B Armster	Severe: wetness, percs slowly.	Severe: wetness.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
03C, 04C2 Armster	Severe: wetness, percs slowly.	Severe: slope, wetness.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
04D3 Armster	Severe: wetness, percs slowly.	Severe: slope, wetness.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
05B Grundy	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack, wetness.
07C2 Knox	Slight	Severe: slope.	Slight	Slight	Good.
07E2, 07F Knox	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
08D3 Knox	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
09B Sharpsburg	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
09C2 Sharpsburg	Severe: wetness, percs slowly.	Severe: slope, wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
11B Ladoga	Severe: percs slowly.	Moderate: seepage, slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
11C2 Ladoga	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
14C2, 14D2 Greenton	Severe: wetness, percs slowly.	Severe: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
16B: Sampsel	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
21B: Wakenda	Moderate: wetness.	Moderate: seepage, slope, wetness.	Moderate: too clayey.	Moderate: wetness.	Fair: too clayey.
21C2: Wakenda	Moderate: wetness.	Severe: slope.	Moderate: too clayey.	Moderate: wetness.	Fair: too clayey.
23C2: Higginsville	Severe: wetness.	Severe: slope, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey, wetness.
25C, 25D: Gosport	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
25F: Gosport	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: depth to rock, slope.
30: Nodaway	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: too clayey, wetness.
32: Colo	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
34: Zook	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
36: Wabash	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
42: Bremer	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
60: Aholt	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
62: Booker	Severe: flooding, ponding, percs slowly.	Slight	Severe: flooding, ponding, too clayey.	Severe: flooding, ponding.	Poor: too clayey, hard to pack, ponding.
64: Cotter	Moderate: flooding, percs slowly.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
66------------------ Gilliam	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: too clayey, wetness.
68------------------ Haynie	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: wetness.
70------------------ Hodge	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, too sandy.	Severe: flooding, seepage.	Poor: too sandy.
72------------------ Kenmoor	Severe: flooding, wetness, percs slowly.	Severe: seepage, flooding.	Severe: flooding, too clayey.	Severe: flooding, seepage.	Poor: too clayey, hard to pack.
74------------------ Landes	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage.	Poor: seepage, too sandy.
76------------------ Leta	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
84------------------ Norborne	Moderate: flooding, percs slowly.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.
86------------------ Parkville	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, wetness.	Poor: wetness.
88------------------ Bremer	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
90------------------ Waldron	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
92------------------ Waubonsie	Severe: flooding, wetness, percs slowly.	Severe: seepage, flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: too clayey, wetness.
100. Udorthents					

TABLE 13.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
01B, 02C2 Lagonda	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
03B, 03C, 04C2, 04D3 Armster	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
05B Grundy	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
07C2 Knox	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
07E2 Knox	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
07F Knox	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
08D3 Knox	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope.
09B Sharpsburg	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
09C2 Sharpsburg	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
11B, 11C2 Ladoga	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
14C2, 14D2 Greenton	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
16B Sampsel	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
21B, 21C2 Wakenda	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
23C2 Higginsville	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
25C, 25D Gosport	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
25F Gosport	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
30 Nodaway	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
32 Colo	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
34 Zook	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
36 Wabash	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
42 Bremer	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
60 Aholt	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
62 Booker	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
64 Cotter	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
66 Gilliam	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
68 Haynie	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
70 Hodge	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
72 Kenmoor	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
74 Landes	Good	Probable	Improbable: too sandy.	Fair: small stones, thin layer.
76 Leta	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
84 Norborne	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
86 Parkville	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
88 Bremer	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
90-------------------- Waldron	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
92-------------------- Waubonsie	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
100. Udorthents				

TABLE 14.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the "Glossary." See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
01B, 02C2 Lagonda	Moderate: slope.	Moderate: hard to pack, wetness.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Erodes easily, wetness.	Erodes easily, percs slowly.
03B, 03C, 04C2 Armster	Moderate: slope.	Moderate: hard to pack.	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
04D3 Armster	Severe: slope.	Moderate: hard to pack.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
05B Grundy	Moderate: slope.	Severe: hard to pack.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Erodes easily, wetness.	Erodes easily, percs slowly.
07C2 Knox	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
07E2, 07F, 08D3 Knox	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
09B, 09C2 Sharpsburg	Moderate: seepage, slope.	Moderate: wetness.	Deep to water	Slope	Erodes easily	Erodes easily.
11B, 11C2 Ladoga	Moderate: seepage, slope.	Moderate: hard to pack.	Deep to water	Slope	Erodes easily	Erodes easily.
14C2 Greenton	Moderate: slope.	Moderate: hard to pack, wetness.	Percs slowly, slope.	Wetness, percs slowly, slope.	Erodes easily, wetness.	Wetness, erodes easily.
14D2 Greenton	Severe: slope.	Moderate: hard to pack, wetness.	Percs slowly, slope.	Wetness, percs slowly, slope.	Slope, erodes easily, wetness.	Wetness, slope, erodes easily.
16B Sampsel	Moderate: slope.	Severe: hard to pack, wetness.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Erodes easily, wetness.	Wetness, erodes easily.
21B, 21C2 Wakenda	Moderate: seepage, slope.	Slight	Deep to water	Slope	Favorable	Favorable.
23C2 Higginsville	Moderate: seepage, slope.	Moderate: wetness.	Frost action, slope.	Slope, wetness, erodes easily.	Erodes easily, wetness.	Erodes easily.
25C Gosport	Moderate: depth to rock, slope.	Slight	Deep to water	Slope, percs slowly, depth to rock.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
25D, 25F Gosport	Severe: slope.	Slight	Deep to water	Slope, percs slowly, depth to rock.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Features affecting-- Drainage	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
30 Nodaway	Moderate: seepage.	Severe: piping.	Deep to water	Flooding	Erodes easily	Erodes easily.
32 Colo	Moderate: seepage.	Severe: wetness.	Flooding, frost action.	Wetness, flooding.	Wetness	Wetness.
34 Zook	Slight	Severe: hard to pack, wetness.	Percs slowly, flooding, frost action.	Wetness, percs slowly.	Erodes easily, wetness, percs slowly.	Wetness, erodes easily, percs slowly.
36 Wabash	Slight	Severe: hard to pack, wetness.	Percs slowly, flooding.	Wetness, droughty, slow intake.	Wetness, percs slowly.	Wetness, droughty, percs slowly.
42 Bremer	Slight	Severe: hard to pack, wetness.	Flooding, frost action.	Wetness, flooding.	Erodes easily, wetness.	Wetness, erodes easily.
60 Aholt	Slight	Severe: hard to pack, wetness.	Percs slowly, flooding.	Wetness, slow intake, percs slowly.	Wetness, percs slowly.	Wetness, percs slowly.
62 Booker	Slight	Severe: hard to pack, ponding.	Ponding, percs slowly, flooding.	Ponding, slow intake, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
64 Cotter	Moderate: seepage.	Moderate: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
66 Gilliam	Moderate: seepage.	Severe: piping, wetness.	Flooding, frost action.	Wetness, flooding.	Wetness	Favorable.
68 Haynie	Moderate: seepage.	Severe: piping.	Deep to water	Erodes easily, flooding.	Erodes easily	Erodes easily.
70 Hodge	Severe: seepage.	Severe: piping.	Deep to water	Droughty, fast intake.	Too sandy, soil blowing.	Droughty.
72 Kenmoor	Severe: seepage.	Severe: hard to pack.	Percs slowly, flooding.	Wetness, droughty, fast intake.	Wetness, soil blowing, percs slowly.	Droughty, percs slowly.
74 Landes	Severe: seepage.	Severe: seepage, piping.	Deep to water	Favorable	Too sandy, soil blowing.	Favorable.
76 Leta	Moderate: seepage.	Severe: piping, wetness.	Percs slowly, flooding, frost action.	Wetness, slow intake, percs slowly.	Wetness	Wetness, percs slowly.
84 Norborne	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Erodes easily	Erodes easily.
86 Parkville	Severe: seepage.	Severe: piping, wetness.	Percs slowly, flooding, cutbanks cave.	Wetness, percs slowly.	Wetness	Wetness, percs slowly.
88 Bremer	Slight	Severe: hard to pack, wetness.	Frost action	Wetness	Erodes easily, wetness.	Wetness, erodes easily.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
90 Waldron	Slight	Severe: hard to pack, wetness.	Percs slowly, flooding, frost action.	Wetness, percs slowly.	Wetness, percs slowly.	Wetness, percs slowly.
92 Waubonsie	Moderate: seepage.	Severe: piping.	Percs slowly, flooding, frost action.	Wetness, soil blowing, percs slowly.	Erodes easily, wetness, soil blowing.	Erodes easily, percs slowly.
100. Udorthents						

TABLE 15.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
01B--------------- Lagonda	0-7	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	95-100	90-100	20-40	5-15
	7-11	Silty clay loam	CL	A-7	0	100	100	95-100	90-100	40-50	15-25
	11-47	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	95-100	95-100	40-70	25-40
	47-60	Clay loam, clay	CL, CH	A-7	0	95-100	90-100	90-100	75-90	40-65	25-40
02C2------------- Lagonda	0-7	Silty clay loam	CL	A-7	0	100	100	95-100	90-100	40-50	15-25
	7-47	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	95-100	95-100	40-70	25-40
	47-60	Clay loam, clay	CL, CH	A-7	0	95-100	90-100	90-100	75-90	40-65	25-40
03B, 03C--------- Armster	0-6	Loam-------------	CL	A-6	0	95-100	80-95	75-90	55-80	25-40	11-20
	6-60	Clay loam, clay	CL, CH	A-7	0	95-100	80-95	70-90	55-80	45-60	25-35
04C2, 04D3------- Armster	0-6	Clay loam--------	CL	A-7	0	95-100	80-95	70-90	55-80	40-50	25-35
	6-60	Clay loam, clay	CL, CH	A-7	0	95-100	80-95	70-90	55-80	45-60	25-35
05B-------------- Grundy	0-8	Silt loam--------	CL	A-6, A-7	0	100	100	95-100	90-100	30-45	10-20
	8-13	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	95-100	90-100	45-55	25-35
	13-29	Silty clay-------	CH	A-7	0	100	100	95-100	90-100	50-70	30-45
	29-60	Silty clay loam	CH, CL	A-7	0	100	100	90-100	90-100	40-55	25-35
07C2, 07E2, 07F-- Knox	0-6	Silt loam--------	CL-ML, CL, ML	A-4, A-6	0	100	100	95-100	90-100	20-35	2-15
	6-46	Silty clay loam, silt loam.	CL	A-7	0	100	100	95-100	95-100	40-50	20-30
	46-60	Silt loam--------	CL	A-6, A-7	0	100	100	95-100	90-100	30-45	10-25
08D3------------- Knox	0-4	Silty clay loam	CL	A-6	0	100	100	95-100	95-100	30-35	10-15
	4-54	Silty clay loam, silt loam.	CL	A-7	0	100	100	95-100	95-100	40-50	20-30
	54-60	Silt loam--------	CL	A-6, A-7	0	100	100	95-100	90-100	30-45	10-25
09B-------------- Sharpsburg	0-10	Silt loam--------	CL	A-6	0	100	100	100	95-100	25-40	10-20
	10-50	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	40-60	20-35
	50-60	Silty clay loam	CL	A-7, A-6	0	100	100	100	95-100	35-50	20-30
09C2------------- Sharpsburg	0-10	Silt loam--------	CL	A-6	0	100	100	100	95-100	25-40	10-20
	10-50	Silty clay loam	CL, CH	A-7, A-6	0	100	100	100	85-100	35-55	18-32
	50-60	Silty clay loam, silty clay.	CH, CL	A-7	0	100	100	100	95-100	40-60	20-35
11B, 11C2-------- Ladoga	0-7	Silt loam--------	CL, CL-ML	A-6, A-4	0	100	100	100	95-100	25-40	5-15
	7-51	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	100	95-100	40-55	25-35
	51-60	Silty clay loam, silt loam.	CL	A-6	0	100	100	100	95-100	30-40	15-20
14C2, 14D2------- Greenton	0-7	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	95-100	35-45	15-25
	7-31	Silty clay loam, silty clay.	CH	A-7	0	100	100	95-100	95-100	50-70	35-45
	31-60	Silty clay, clay, channery silty clay.	CH	A-7	0-5	65-100	65-100	60-95	55-90	50-70	25-40

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag-ments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct					Pct	
16B-------------- Sampsel	0-16	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-100	35-50	15-25
	16-70	Silty clay loam, silty clay, clay.	CH	A-7	0	100	100	95-100	95-100	52-75	35-47
21B, 21C2-------- Wakenda	0-14	Silt loam--------	CL, ML	A-6, A-4	0	100	100	100	90-100	30-40	5-15
	14-51	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	100	90-100	35-45	15-25
	51-60	Silt loam, silty clay loam.	CL	A-6	0	100	100	100	90-100	30-40	11-20
23C2------------- Higginsville	0-7	Silt loam--------	CL	A-6	0	100	100	95-100	95-100	30-40	10-15
	7-51	Silty clay loam	CL	A-7	0	100	100	95-100	90-100	40-50	15-25
	51-60	Silty clay loam, silt loam.	CL, ML	A-6, A-7	0	100	100	95-100	90-100	35-45	10-20
25C, 25D, 25F---- Gosport	0-5	Silty clay loam	ML, MH	A-7	0	100	90-100	90-100	85-100	41-55	11-20
	5-32	Clay, silty clay, silty clay loam.	CH	A-7	0	100	90-100	90-100	85-100	50-65	35-50
	32-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
30--------------- Nodaway	0-6	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	95-100	95-100	90-100	25-35	5-15
	6-60	Silt loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	95-100	95-100	90-100	25-40	5-15
32--------------- Colo	0-33	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-60	15-30
	33-60	Silty clay loam	CL, CH	A-7	0	100	100	90-100	90-100	40-55	20-30
34--------------- Zook	0-23	Silty clay loam	CH, CL	A-7	0	100	100	95-100	95-100	45-65	20-35
	23-60	Silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	95-100	60-85	35-55
36--------------- Wabash	0-39	Silty clay-------	CH	A-7	0	100	100	100	95-100	50-75	30-50
	39-60	Silty clay, clay	CH	A-7	0	100	100	100	95-100	52-78	30-55
42--------------- Bremer	0-15	Silt loam--------	CL, ML	A-6, A-7	0	100	100	100	95-100	35-45	10-20
	15-53	Silty clay loam, silty clay.	CH, MH	A-7	0	100	100	100	95-100	50-65	20-35
	53-60	Silty clay loam	CH, CL	A-7	0	100	100	95-100	95-100	40-60	25-40
60--------------- Aholt	0-10	Silty clay-------	CH	A-7-6	0	100	100	95-100	90-100	60-80	35-55
	10-47	Clay, silty clay	CH	A-7-6	0	100	100	95-100	90-100	60-80	35-55
	47-60	Silty clay, silty clay loam.	CL, CH	A-7-6	0	100	100	85-100	85-100	45-60	30-40
62--------------- Booker	0-12	Silty clay-------	CL, CH	A-7	0	100	100	95-100	95-100	45-75	30-45
	12-31	Clay-------------	CH	A-7	0	100	100	100	95-100	65-85	40-55
	31-60	Clay, silty clay	CH	A-7	0	100	100	95-100	95-100	50-75	30-45
64--------------- Cotter	0-14	Silt loam--------	CL	A-6	0	100	100	90-100	80-95	30-40	13-20
	14-30	Silty clay loam, silt loam.	CL	A-6	0	100	100	95-100	80-90	30-40	14-22
	30-60	Loam, silt loam	CL	A-4, A-6	0	100	100	90-100	65-80	25-40	8-18
66--------------- Gilliam	0-16	Silt loam--------	CL	A-6, A-4	0	100	100	95-100	85-100	25-40	8-20
	16-22	Silt loam, silty clay loam, loam.	CL	A-6, A-4	0	100	100	90-100	80-95	25-40	8-20
	22-60	Stratified silty clay loam to loam.	CL-ML, CL	A-4, A-6	0	100	100	90-100	80-95	20-40	5-20

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
68--------------- Haynie	0-9	Very fine sandy loam.	CL-ML, CL	A-4, A-6	0	100	100	85-100	70-100	25-40	5-15
	9-60	Silt loam, very fine sandy loam.	CL-ML, CL	A-4, A-6	0	100	100	85-100	85-100	25-35	5-15
70--------------- Hodge	0-6	Loamy fine sand	SM	A-2, A-4	0	100	100	90-100	25-45	---	NP
	6-60	Loamy fine sand, fine sand.	SM	A-2, A-4	0	100	100	90-100	25-45	---	NP
72--------------- Kenmoor	0-6	Loamy fine sand	SM	A-2, A-4	0	100	100	75-95	15-45	---	NP
	6-28	Sand, loamy fine sand, fine sand.	SM	A-2, A-4	0	100	100	65-80	15-40	---	NP
	28-60	Silty clay loam, silty clay, clay.	CH, CL	A-7	0	100	100	95-100	75-95	40-70	25-45
74--------------- Landes	0-20	Fine sandy loam	SM, SC, SC-SM	A-4, A-2	0	100	95-100	85-95	20-50	<25	NP-10
	20-43	Fine sandy loam, loam, loamy fine sand.	SM, ML, CL-ML, SC-SM	A-2, A-4	0	100	85-100	70-95	20-70	<25	NP-10
	43-60	Stratified sand to silt loam.	SM, ML, SP-SM, SC	A-2, A-4	0	100	95-100	60-95	10-70	<30	NP-10
76--------------- Leta	0-12	Silty clay-------	CL, CH	A-7	0	100	100	95-100	95-100	45-65	30-45
	12-25	Silty clay loam, silty clay.	CL, CH	A-6, A-7	0	100	100	95-100	90-100	35-65	20-40
	25-60	Stratified silt loam to sandy loam.	CL-ML, CL	A-4, A-6	0	100	100	80-100	51-95	20-35	5-15
84--------------- Norborne	0-14	Loam-------------	ML, CL-ML	A-4	0	100	100	90-100	60-75	<20	2-6
	14-46	Loam, silt loam, very fine sandy loam.	CL-ML, CL	A-4	0	100	100	90-100	60-75	<25	5-10
	46-60	Loam, very fine sandy loam, fine sandy loam.	ML, CL-ML	A-4	0	100	100	85-100	50-75	<20	2-6
86--------------- Parkville	0-10	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-100	35-50	15-25
	10-17	Clay, silty clay	CH	A-7	0	100	100	95-100	95-100	55-80	30-55
	17-60	Stratified very fine sand to silt loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	85-100	60-90	20-35	NP-15
88--------------- Bremer	0-12	Silty clay loam	CH, CL	A-7	0	100	100	100	95-100	45-60	25-40
	12-53	Silty clay loam, silty clay.	CH, MH	A-7	0	100	100	100	95-100	50-65	20-35
	53-60	Silty clay loam	CH, CL	A-7	0	100	100	95-100	95-100	40-60	25-40
90--------------- Waldron	0-8	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-100	30-45	15-25
	8-60	Stratified silty clay loam to clay.	CL, CH	A-7	0	100	100	95-100	90-100	40-65	20-45

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
92---------------- Waubonsie	0-7	Fine sandy loam	SM, SC, SC-SM	A-4	0	100	100	70-85	40-50	<25	2-10
	7-20	Fine sandy loam	SM, SC, ML, CL	A-4	0	100	100	70-90	40-60	<25	2-10
	20-36	Clay, silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	85-95	60-85	40-60
	36-60	Stratified very fine sandy loam to silty clay loam.	ML, CL	A-4, A-6	0	100	100	85-100	50-65	25-40	5-15
100. Udorthents											

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
01B--------------	0-7	12-27	1.35-1.50	0.6-2.0	0.21-0.24	5.6-7.3	Moderate-----	0.37	3	6	2-4
Lagonda	7-11	27-35	1.35-1.50	0.2-0.6	0.18-0.20	5.6-7.3	Moderate-----	0.37			
	11-47	32-50	1.30-1.40	0.06-0.2	0.13-0.18	5.6-7.3	High---------	0.37			
	47-60	28-45	1.30-1.40	0.06-0.2	0.08-0.16	6.6-7.8	High---------	0.37			
02C2-------------	0-7	27-32	1.35-1.50	0.2-0.6	0.18-0.20	5.6-7.3	Moderate-----	0.37	2	7	.5-2
Lagonda	7-47	32-50	1.30-1.40	0.06-0.2	0.13-0.18	5.6-7.3	High---------	0.37			
	47-60	28-45	1.30-1.40	0.06-0.2	0.08-0.16	6.6-7.8	High---------	0.37			
03B, 03C---------	0-6	15-27	1.35-1.50	0.6-2.0	0.17-0.20	4.5-7.3	Moderate-----	0.37	5	6	1-2
Armster	6-60	35-48	1.35-1.45	0.2-0.6	0.10-0.18	4.5-7.3	High---------	0.37			
04C2, 04D3-------	0-6	27-40	1.35-1.45	0.2-0.6	0.10-0.18	4.5-7.3	Moderate-----	0.37	4	6	.5-1
Armster	6-60	35-48	1.35-1.45	0.2-0.6	0.10-0.18	4.5-7.3	High---------	0.37			
05B--------------	0-8	12-27	1.35-1.50	0.6-2.0	0.22-0.24	5.6-7.3	Moderate-----	0.37	3	6	2-4
Grundy	8-13	32-45	1.35-1.45	0.2-0.6	0.18-0.20	5.6-6.5	High---------	0.37			
	13-29	40-50	1.30-1.40	0.06-0.2	0.11-0.13	5.1-7.3	High---------	0.37			
	29-60	28-35	1.35-1.40	0.06-0.2	0.18-0.20	5.6-7.3	High---------	0.37			
07C2, 07E2, 07F--	0-6	18-27	1.20-1.30	0.6-2.0	0.22-0.24	5.6-7.3	Low----------	0.32	5	6	1-3
Knox	6-46	25-35	1.30-1.40	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.43			
	46-60	18-27	1.20-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Low----------	0.43			
08D3-------------	0-4	27-30	1.20-1.30	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.32	4	7	.5-1
Knox	4-54	25-35	1.30-1.40	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.43			
	54-60	18-27	1.20-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Low----------	0.43			
09B--------------	0-10	25-27	1.30-1.35	0.6-2.0	0.21-0.23	5.1-7.3	Moderate-----	0.32	5	6	2-4
Sharpsburg	10-50	36-42	1.35-1.40	0.2-0.6	0.18-0.20	5.1-6.0	Moderate-----	0.43			
	50-60	30-38	1.40-1.45	0.6-2.0	0.18-0.20	5.1-6.5	Moderate-----	0.43			
09C2-------------	0-10	25-27	1.30-1.35	0.6-2.0	0.21-0.23	5.1-7.3	Moderate-----	0.32	5	6	3-4
Sharpsburg	10-50	27-36	1.30-1.35	0.6-2.0	0.21-0.23	5.1-7.3	Moderate-----	0.43			
	50-60	36-42	1.35-1.40	0.2-0.6	0.18-0.20	5.1-6.0	Moderate-----	0.43			
11B, 11C2--------	0-7	18-27	1.30-1.35	0.6-2.0	0.22-0.24	6.1-7.3	Low----------	0.32	5	6	2-3
Ladoga	7-51	36-42	1.30-1.40	0.2-0.6	0.18-0.20	5.1-6.0	Moderate-----	0.43			
	51-60	24-32	1.35-1.45	0.6-2.0	0.18-0.20	5.1-6.5	Moderate-----	0.43			
14C2, 14D2-------	0-7	27-35	1.30-1.45	0.2-0.6	0.12-0.18	5.6-7.3	Moderate-----	0.37	2	7	1-3
Greenton	7-31	35-50	1.35-1.50	0.06-0.2	0.11-0.15	5.6-7.3	High---------	0.37			
	31-60	40-50	1.35-1.50	0.06-0.2	0.08-0.12	6.6-7.8	High---------	0.37			
16B--------------	0-16	27-35	1.30-1.50	0.2-0.6	0.21-0.24	5.6-7.3	Moderate-----	0.37	2	7	3-4
Sampsel	16-70	35-60	1.40-1.60	0.06-0.2	0.11-0.13	5.6-7.8	High---------	0.37			
21B, 21C2--------	0-14	20-27	1.20-1.30	0.6-2.0	0.20-0.24	5.6-7.3	Low----------	0.28	5	6	3-4
Wakenda	14-51	25-35	1.30-1.50	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-----	0.28			
	51-60	20-30	1.20-1.50	0.6-2.0	0.20-0.22	5.6-7.3	Moderate-----	0.43			
23C2-------------	0-7	20-27	1.30-1.50	0.6-2.0	0.21-0.24	5.6-7.3	Low----------	0.37	5	6	3-4
Higginsville	7-51	27-35	1.40-1.50	0.6-2.0	0.18-0.20	5.1-6.5	Moderate-----	0.37			
	51-60	25-30	1.50-1.60	0.6-2.0	0.18-0.22	5.1-6.5	Moderate-----	0.37			
25C, 25D, 25F----	0-5	27-34	1.30-1.40	0.2-0.6	0.14-0.16	5.1-7.3	Moderate-----	0.43	3	7	2-3
Gosport	5-32	36-60	1.50-1.60	<0.06	0.12-0.14	3.6-5.5	High---------	0.32			
	32-60	---	---	<0.06	---	---	-------------	----			

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
30----------------- Nodaway	0-6	18-27	1.25-1.35	0.6-2.0	0.20-0.23	6.1-7.3	Low-----------	0.32	5	6	2-3
	6-60	18-28	1.25-1.35	0.6-2.0	0.20-0.23	6.1-7.3	Moderate------	0.43			
32----------------- Colo	0-33	27-36	1.28-1.32	0.6-2.0	0.21-0.23	5.6-7.3	Moderate------	0.28	5	7	5-7
	33-60	30-35	1.25-1.35	0.6-2.0	0.18-0.20	5.6-7.3	Moderate------	0.28			
34----------------- Zook	0-23	35-40	1.30-1.35	0.2-0.6	0.21-0.23	5.6-7.3	High----------	0.37	5	7	5-7
	23-60	36-45	1.30-1.45	0.06-0.2	0.11-0.13	5.6-7.8	High----------	0.28			
36----------------- Wabash	0-39	40-46	1.25-1.45	<0.06	0.12-0.14	5.1-7.3	Very high-----	0.28	5	4	2-4
	39-60	40-60	1.20-1.45	<0.06	0.08-0.12	5.1-7.8	Very high-----	0.28			
42----------------- Bremer	0-15	22-27	1.25-1.30	0.6-2.0	0.21-0.25	5.6-7.3	Moderate------	0.32	5	6	3-5
	15-53	35-42	1.30-1.40	0.2-0.6	0.15-0.17	5.6-6.5	High----------	0.43			
	53-60	32-38	1.40-1.45	0.2-0.6	0.18-0.20	5.6-6.5	High----------	0.43			
60----------------- Aholt	0-10	50-60	1.20-1.30	<0.06	0.11-0.13	6.6-8.4	Very high-----	0.28	5	4	2-4
	10-47	50-80	1.20-1.30	<0.06	0.11-0.13	6.6-8.4	Very high-----	0.28			
	47-60	35-60	1.25-1.40	<0.06	0.11-0.15	6.6-8.4	High----------	0.28			
62----------------- Booker	0-12	40-70	1.30-1.50	<0.06	0.12-0.14	5.6-7.3	Very high-----	0.28	5	4	1-3
	12-31	60-75	1.30-1.45	<0.06	0.09-0.11	5.6-7.3	Very high-----	0.28			
	31-60	50-70	1.30-1.50	<0.06	0.12-0.14	5.6-7.3	Very high-----	0.28			
64----------------- Cotter	0-14	18-27	1.35-1.45	0.6-2.0	0.21-0.25	5.6-7.8	Moderate------	0.32	5	6	3-4
	14-30	25-35	1.25-1.40	0.6-2.0	0.18-0.21	5.1-7.3	Moderate------	0.43			
	30-60	18-27	1.30-1.45	0.6-2.0	0.20-0.22	5.1-7.3	Low-----------	0.43			
66----------------- Gilliam	0-16	15-20	1.25-1.40	0.6-2.0	0.20-0.24	6.6-8.4	Moderate------	0.28	5	4L	2-4
	16-22	15-35	1.30-1.45	0.6-2.0	0.17-0.22	7.4-8.4	Moderate------	0.28			
	22-60	12-35	1.30-1.45	0.6-2.0	0.17-0.22	7.4-8.4	Moderate------	0.28			
68----------------- Haynie	0-9	15-25	1.20-1.35	0.6-2.0	0.18-0.23	7.4-8.4	Low-----------	0.37	5	4L	1-3
	9-60	15-18	1.20-1.35	0.6-2.0	0.18-0.23	7.4-8.4	Low-----------	0.37			
70----------------- Hodge	0-6	5-15	1.40-1.50	6.0-20	0.07-0.12	6.6-7.8	Low-----------	0.17	5	2	.5-1
	6-60	5-12	1.40-1.55	6.0-20	0.06-0.10	6.6-7.8	Low-----------	0.17			
72----------------- Kenmoor	0-6	5-10	1.50-1.60	>6.0	0.10-0.12	6.6-8.4	Low-----------	0.17	4	2	<1
	6-28	5-10	1.50-1.60	>6.0	0.05-0.12	6.6-8.4	Low-----------	0.17			
	28-60	35-60	1.30-1.50	0.06-0.2	0.12-0.19	6.6-8.4	High----------	0.32			
74----------------- Landes	0-20	5-20	1.40-1.60	2.0-6.0	0.13-0.18	5.6-8.4	Low-----------	0.20	4	3	1-2
	20-43	5-18	1.45-1.70	2.0-6.0	0.10-0.15	5.6-8.4	Low-----------	0.20			
	43-60	5-18	1.60-1.70	6.0-20	0.05-0.15	5.6-8.4	Low-----------	0.20			
76----------------- Leta	0-12	40-48	1.30-1.50	0.06-0.2	0.12-0.14	6.6-7.8	High----------	0.28	5	4	2-4
	12-25	35-48	1.30-1.50	0.06-0.2	0.11-0.19	7.4-7.8	High----------	0.28			
	25-60	10-27	1.30-1.50	0.6-2.0	0.14-0.22	7.4-8.4	Low-----------	0.28			
84----------------- Norborne	0-14	8-12	1.20-1.40	0.6-2.0	0.20-0.24	5.6-7.3	Low-----------	0.28	5	5	2-4
	14-46	12-18	1.20-1.40	0.6-2.0	0.17-0.22	5.6-7.3	Low-----------	0.43			
	46-60	9-13	1.20-1.40	0.6-2.0	0.14-0.22	5.6-7.3	Low-----------	0.43			
86----------------- Parkville	0-10	35-40	1.30-1.50	0.06-0.2	0.12-0.21	6.6-8.4	Moderate------	0.28	5	4	1-3
	10-17	40-70	1.30-1.50	<0.06	0.11-0.13	6.6-8.4	High----------	0.28			
	17-60	4-25	1.40-1.60	0.6-2.0	0.18-0.22	7.4-8.4	Low-----------	0.28			
88----------------- Bremer	0-12	27-36	1.25-1.30	0.6-2.0	0.21-0.23	5.6-7.3	Moderate------	0.32	5	7	5-7
	12-53	35-42	1.30-1.40	0.2-0.6	0.15-0.17	5.6-6.5	High----------	0.43			
	53-60	32-38	1.40-1.45	0.2-0.6	0.18-0.20	5.6-6.5	High----------	0.43			

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH					Pct
90---------------- Waldron	0-8	30-35	1.35-1.50	0.2-0.6	0.21-0.23	6.6-7.8	Moderate-----	0.32	5	7	2-4
	8-60	35-50	1.45-1.60	0.06-0.2	0.10-0.18	7.4-8.4	High---------	0.32			
92---------------- Waubonsie	0-7	12-18	1.30-1.40	2.0-6.0	0.16-0.18	7.4-8.4	Low----------	0.20	5	3	1-2
	7-20	12-18	1.30-1.40	2.0-6.0	0.16-0.18	7.4-8.4	Low----------	0.24			
	20-36	35-60	1.40-1.45	0.06-0.2	0.11-0.13	7.4-8.4	High---------	0.32			
	36-60	16-35	1.30-1.40	0.6-2.0	0.18-0.21	7.4-8.4	Low----------	0.43			
100. Udorthents											

TABLE 17.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
01B, 02C2: Lagonda	C	None	---	---	1.5-3.0	Perched	Nov-Apr	>60	---	High	High	Low.
03B, 03C, 04C2, 04D3: Armster	C	None	---	---	3.0-5.0	Perched	Nov-Apr	>60	---	Moderate	High	Moderate.
05B: Grundy	C	None	---	---	1.5-3.0	Perched	Mar-Apr	>60	---	High	High	Moderate.
07C2, 07E2, 07F, 08D3: Knox	B	None	---	---	>6.0	---	---	>60	---	High	Low	Low.
09B, 09C2: Sharpsburg	B	None	---	---	3.0-5.0	Apparent	Nov-May	>60	---	High	Moderate	Moderate.
11B, 11C2: Ladoga	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
14C2, 14D2: Greenton	C	None	---	---	1.5-3.0	Perched	Nov-Apr	>60	---	Moderate	High	Moderate.
16B: Sampsel	D	None	---	---	0-1.5	Perched	Nov-May	>60	---	High	High	Low.
21B, 21C2: Wakenda	B	None	---	---	4.0-6.0	Perched	Nov-Apr	>60	---	High	Low	Moderate.
23C2: Higginsville	C	None	---	---	1.5-3.0	Perched	Nov-Apr	>60	---	High	Moderate	Moderate.
25C, 25D, 25F: Gosport	C	None	---	---	>6.0	---	---	20-40	Soft	Moderate	High	High.
30: Nodaway	B	Frequent	Very brief to brief.	Nov-May	3.0-5.0	Apparent	Apr-May	>60	---	High	Moderate	Low.
32: Colo	B/D	Occasional	Brief	Nov-May	1.0-3.0	Apparent	Nov-May	>60	---	High	High	Moderate.
34: Zook	C/D	Occasional	Brief	Nov-May	0-3.0	Apparent	Nov-May	>60	---	High	High	Moderate.
36: Wabash	D	Occasional	Brief to long.	Nov-May	0-1.0	Apparent	Nov-May	>60	---	Moderate	High	Moderate.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hardness	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In				
42----------------- Bremer	C	Occasional	Very brief	Nov-May	1.0-2.0	Apparent	Nov-May	>60	---	High-----	Moderate	Moderate.
60----------------- Aholt	D	Occasional	Brief-----	Nov-May	0-1.0	Apparent	Nov-May	>60	---	Moderate	High-----	Low.
62----------------- Booker	D	Occasional	Brief to long.	Nov-May	+.5-1.0	Apparent	Nov-May	>60	---	Moderate	High-----	Moderate.
64----------------- Cotter	B	Rare---------	---	---	>6.0	---	---	>60	---	High-----	Moderate	Moderate.
66----------------- Gilliam	C	Occasional	Brief-----	Nov-May	1.5-3.0	Apparent	Nov-May	>60	---	High-----	High-----	Low.
68----------------- Haynie	B	Occasional	Very brief to long.	Nov-May	3.0-6.0	Apparent	Nov-May	>60	---	High-----	Low------	Low.
70----------------- Hodge	A	Occasional	Brief to long.	Nov-May	>6.0	---	---	>60	---	Low------	Low------	Low.
72----------------- Kenmoor	B	Occasional	Brief-----	Nov-May	2.5-3.0	Perched	Nov-May	>60	---	Moderate	High-----	Low.
74----------------- Landes	B	Occasional	Brief-----	Nov-May	4.0-6.0	Apparent	Mar-May	>60	---	Moderate	Low------	Low.
76----------------- Leta	C	Occasional	Brief-----	Nov-May	1.0-3.0	Apparent	Nov-May	>60	---	High-----	High-----	Low.
84----------------- Norborne	B	Rare---------	---	---	>6.0	---	---	>60	---	Moderate	Low------	Moderate.
86----------------- Parkville	C	Occasional	Brief-----	Nov-Jun	1.0-2.0	Apparent	Nov-Apr	>60	---	Moderate	High-----	Low.
88----------------- Bremer	C	Rare---------	---	---	1.0-2.0	Apparent	Nov-May	>60	---	High-----	Moderate	Moderate.
90----------------- Waldron	D	Occasional	Brief to long.	Nov-May	1.0-3.0	Apparent	Nov-May	>60	---	High-----	High-----	Low.
92----------------- Waubonsie	B	Occasional	Brief-----	Feb-Nov	2.0-4.0	Apparent	Nov-May	>60	---	High-----	High-----	Low.
100. Udorthents												

TABLE 18.--CLASSIFICATION OF THE SOILS

(An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series)

Soil name	Family or higher taxonomic class
Aholt	Very fine, montmorillonitic (calcareous), mesic Vertic Haplaquolls
Armster	Fine, montmorillonitic, mesic Mollic Hapludalfs
Booker	Very fine, montmorillonitic, mesic Vertic Haplaquolls
Bremer	Fine, montmorillonitic, mesic Typic Argiaquolls
Colo	Fine-silty, mixed, mesic Cumulic Haplaquolls
Cotter	Fine-silty, mixed, mesic Typic Argiudolls
Gilliam	Fine-silty, mixed, mesic Fluvaquentic Hapludolls
Gosport	Fine, illitic, mesic Typic Dystrochrepts
*Greenton	Fine, montmorillonitic, mesic Aquic Argiudolls
Grundy	Fine, montmorillonitic, mesic Aquic Argiudolls
Haynie	Coarse-silty, mixed (calcareous), mesic Mollic Udifluvents
*Higginsville	Fine-silty, mixed, mesic Aquic Argiudolls
Hodge	Mixed, mesic Typic Udipsamments
Kenmoor	Sandy over clayey, mixed (calcareous), mesic Aquic Udifluvents
Knox	Fine-silty, mixed, mesic Mollic Hapludalfs
Ladoga	Fine, montmorillonitic, mesic Mollic Hapludalfs
Lagonda	Fine, montmorillonitic, mesic Aquic Argiudolls
*Landes	Coarse-loamy, mixed, mesic Fluventic Hapludolls
Leta	Clayey over loamy, montmorillonitic, mesic Fluvaquentic Hapludolls
Nodaway	Fine-silty, mixed, nonacid, mesic Mollic Udifluvents
Norborne	Coarse-loamy, mixed, mesic Typic Argiudolls
Parkville	Clayey over loamy, montmorillonitic, mesic Fluvaquentic Hapludolls
Sampsel	Fine, montmorillonitic, mesic, sloping Typic Argiaquolls
Sharpsburg	Fine, montmorillonitic, mesic Typic Argiudolls
Udorthents	Mexid, mesic Typic Udorthents
Wabash	Fine, montmorillonitic, mesic Vertic Haplaquolls
Wakenda	Fine-silty, mixed, mesic Typic Argiudolls
Waldron	Fine, montmorillonitic (calcareous), mesic Aeric Fluvaquents
Waubonsie	Coarse-loamy over clayey, mixed (calcareous), mesic Aquic Udifluvents
Zook	Fine, montmorillonitic, mesic Cumulic Haplaquolls

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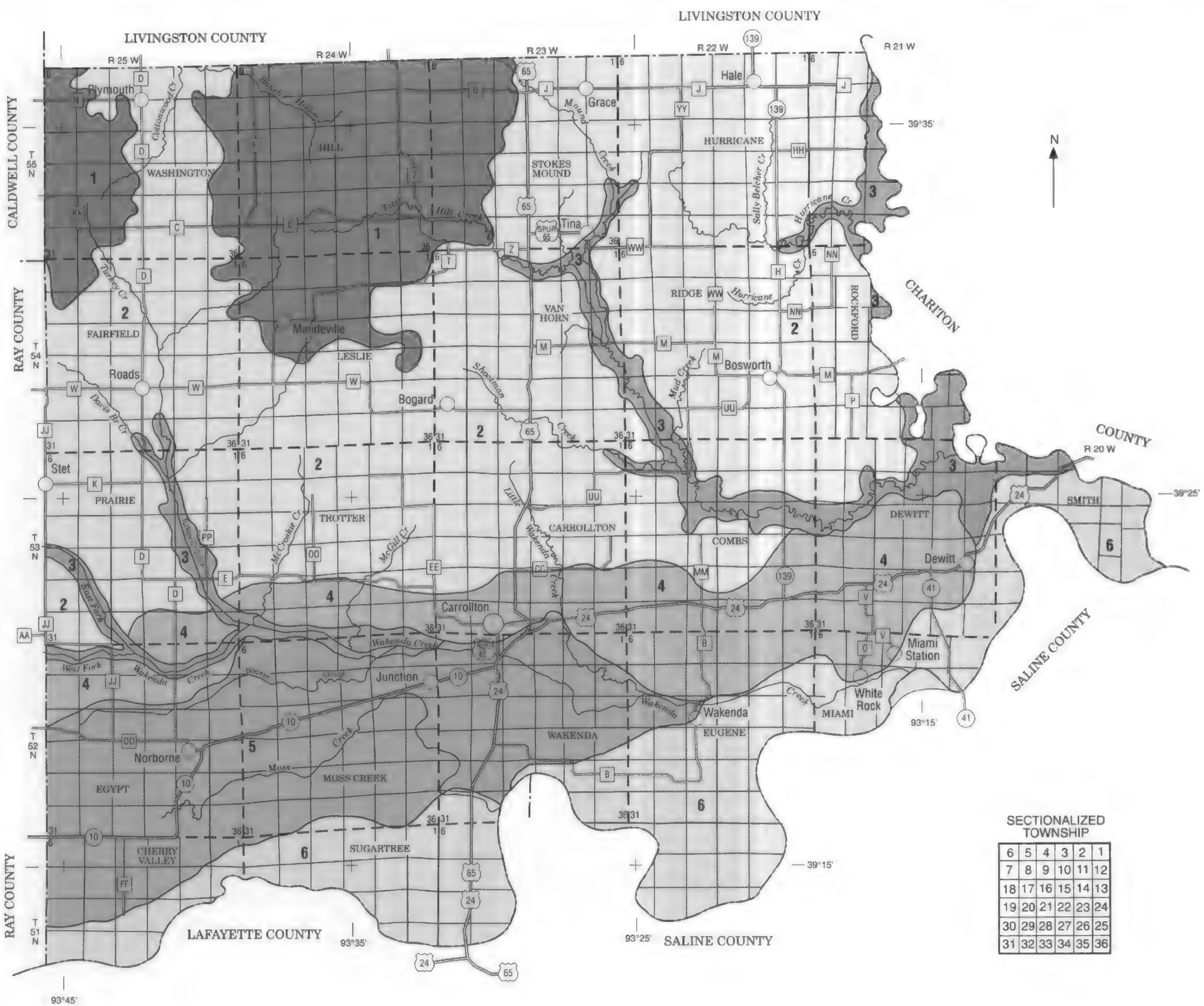


6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

SOIL LEGEND*

1	Gosport-Greenton-Sharpsburg association
2	Lagonda-Armster-Grundy association
3	Colo-Nodaway association
4	Knox-Higginsville-Wakenda association
5	Bremer-Cotter-Booker association
6	Leta-Haynie-Waldron association

* The units on this legend are described in the text under the heading "General Soil Map Units."

Compiled 1993

Index Map Welcome Page Manuscript

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
MISSOURI AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

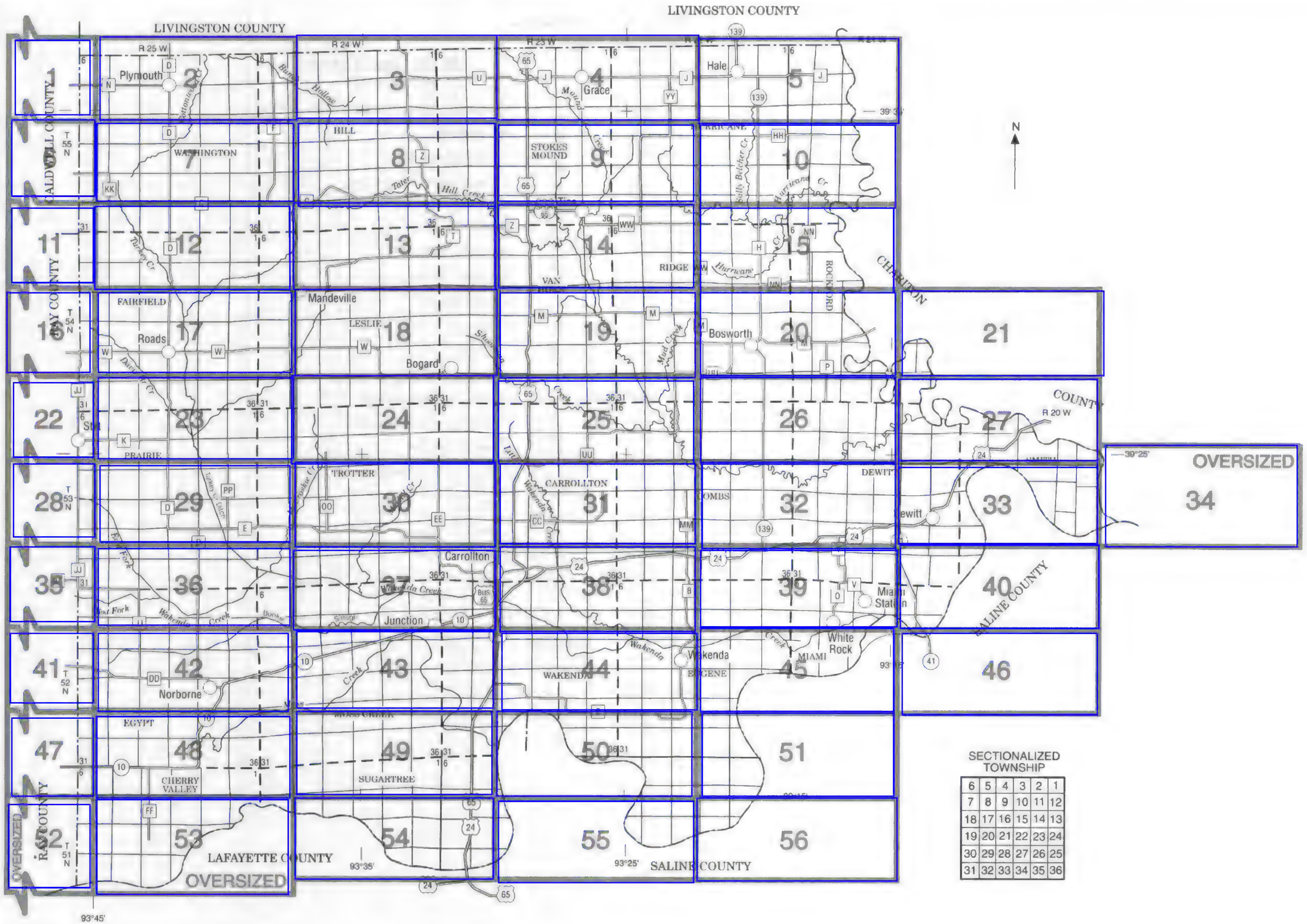
CARROLL COUNTY, MISSOURI

Scale 1:253,440

1 0 1 2 3 4 Miles

1 0 4 8 Km

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



General Soil Map

Welcome Page

Manuscript

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

INDEX TO MAP SHEETS

CARROLL COUNTY, MISSOURI

Scale 1:253,440

Miles 1 0 1 2 3 4

Km 1 0 4 8

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

CARROLL COUNTY, MISSOURI

MISSOURI AGRICULTURAL EXPERIMENT STATION

SOIL LEGEND

Map symbols consist of numbers or a combination of numbers and a letter. The initial numbers represent the kind of soil. A capital letter following these numbers indicates the class of slope. Symbols without a slope letter are for nearly level soils, or areas mapped at a higher taxonomic level. A final number of 2 following the slope letter indicates that the soil is eroded, and 3 indicates that the soil is severely eroded.

SYMBOL	NAME
01B	Lagonda silt loam, 2 to 5 percent slopes
02C2	Lagonda silty clay loam, 5 to 9 percent slopes, eroded
03B	Armster loam, 2 to 5 percent slopes
03C	Armster loam, 5 to 9 percent slopes
04C2	Armster clay loam, 5 to 9 percent slopes, eroded
04D3	Armster clay loam, 9 to 14 percent slopes, severely eroded
05B	Grundy silt loam, 2 to 5 percent slopes
07C2	Knox silt loam, 5 to 9 percent slopes, eroded
07E2	Knox silt loam, 14 to 20 percent slopes, eroded
07F	Knox silt loam, 20 to 30 percent slopes
08D3	Knox silty clay loam, 9 to 14 percent slopes, severely eroded
09B	Sharpsburg silt loam, 2 to 5 percent slopes
09C2	Sharpsburg silt loam, 5 to 9 percent slopes, eroded
11B	Ladoga silt loam, 2 to 5 percent slopes
11C2	Ladoga silt loam, 5 to 9 percent slopes, eroded
14C2	Greenton silty clay loam, 5 to 9 percent slopes, eroded
14D2	Greenton silty clay loam, 9 to 14 percent slopes, eroded
16B	Sampsel silty clay loam, 2 to 5 percent slopes
21B	Wakenda silt loam, 2 to 5 percent slopes
21C2	Wakenda silt loam, 5 to 9 percent slopes, eroded
23C2	Higginsville silt loam, 5 to 9 percent slopes, eroded
25C	Gosport silty clay loam, 5 to 9 percent slopes
25D	Gosport silty clay loam, 9 to 14 percent slopes
25F	Gosport silty clay loam, 14 to 30 percent slopes
30	Nodaway silt loam
32	Colo silty clay loam
34	Zook silty clay loam
[illegible]	Wabash silty clay
42	Bremer silt loam, occasionally flooded
60	Aholt silty clay
62	Booker silty clay
64	Cotter silt loam
[illegible]	Gilliam silt loam
[illegible]	Haynie very fine sandy loam
70	Hodge loamy fine sand
72	Kenmoor loamy fine sand
74	Landes fine sandy loam
76	Leta silty clay
[illegible]	Norborne loam
[illegible]	Parkville silty clay loam
[illegible]	Bremer silty clay loam, rarely flooded
[illegible]	Waldron silty clay loam
92	Waubonsie fine sandy loam, loamy substratum
100	Udorthents, nearly level to strongly sloping

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state, or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline and neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool

STATE COORDINATE TICK
1 890 000 FEET

LAND DIVISION CORNER
(sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEM & DESIGNATIONS

- Interstate
- Federal
- State
- County, farm or ranch

RAILROAD

POWER TRANSMISSION LINE
(normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or Small

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban area)
- Church
- School
- Indian mound (label)
- Located object (label)
- Tank (label)
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label)
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial
- Intermittent

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

DEPRESSION OR SINK

SOIL SAMPLE (normally not shown)

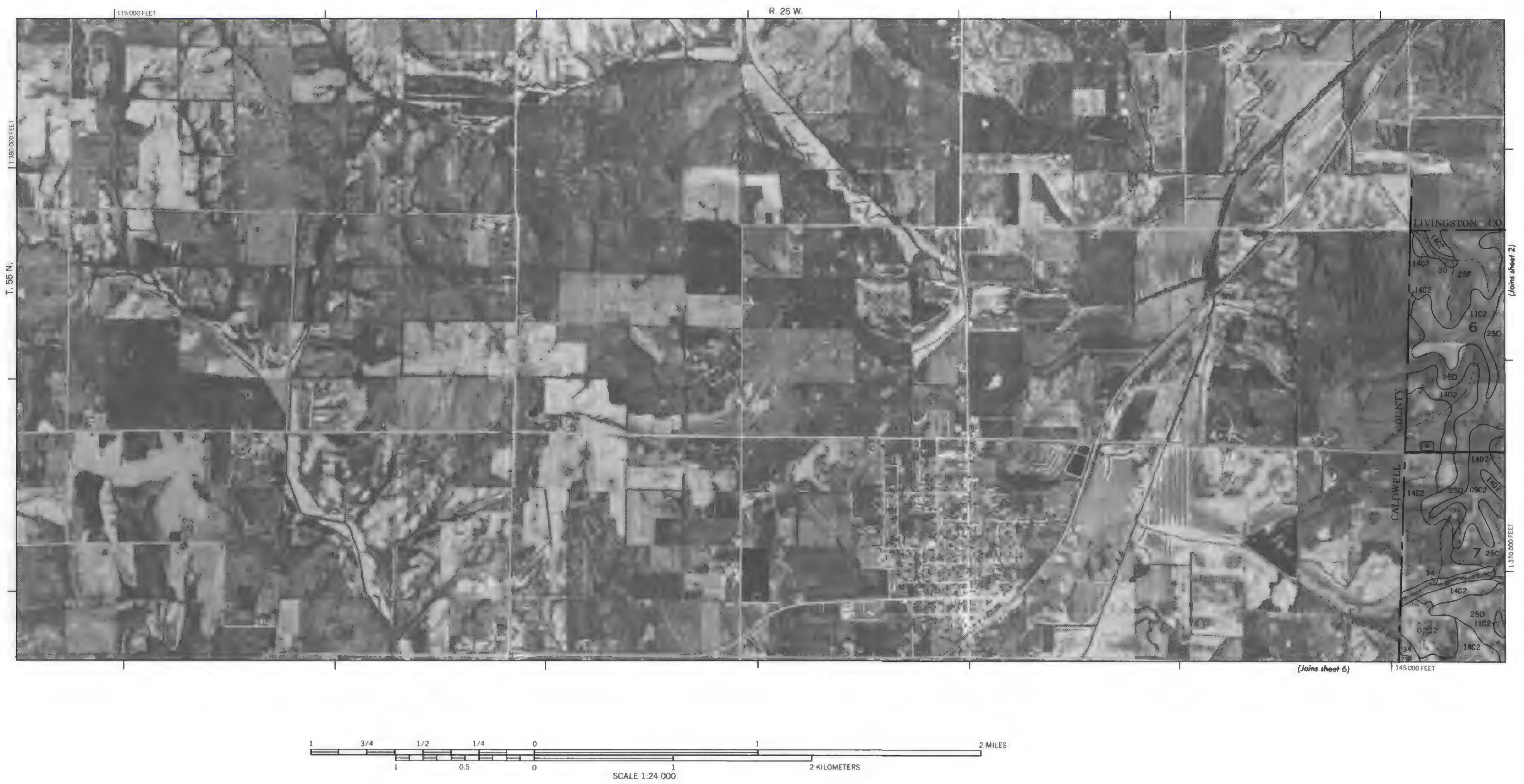
MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)

SOIL SURVEY OF CARROLL COUNTY, MISSOURI — SHEET NUMBER 1

1

N



SOIL SURVEY OF CARROLL COUNTY, MISSOURI — SHEET NUMBER 2

2

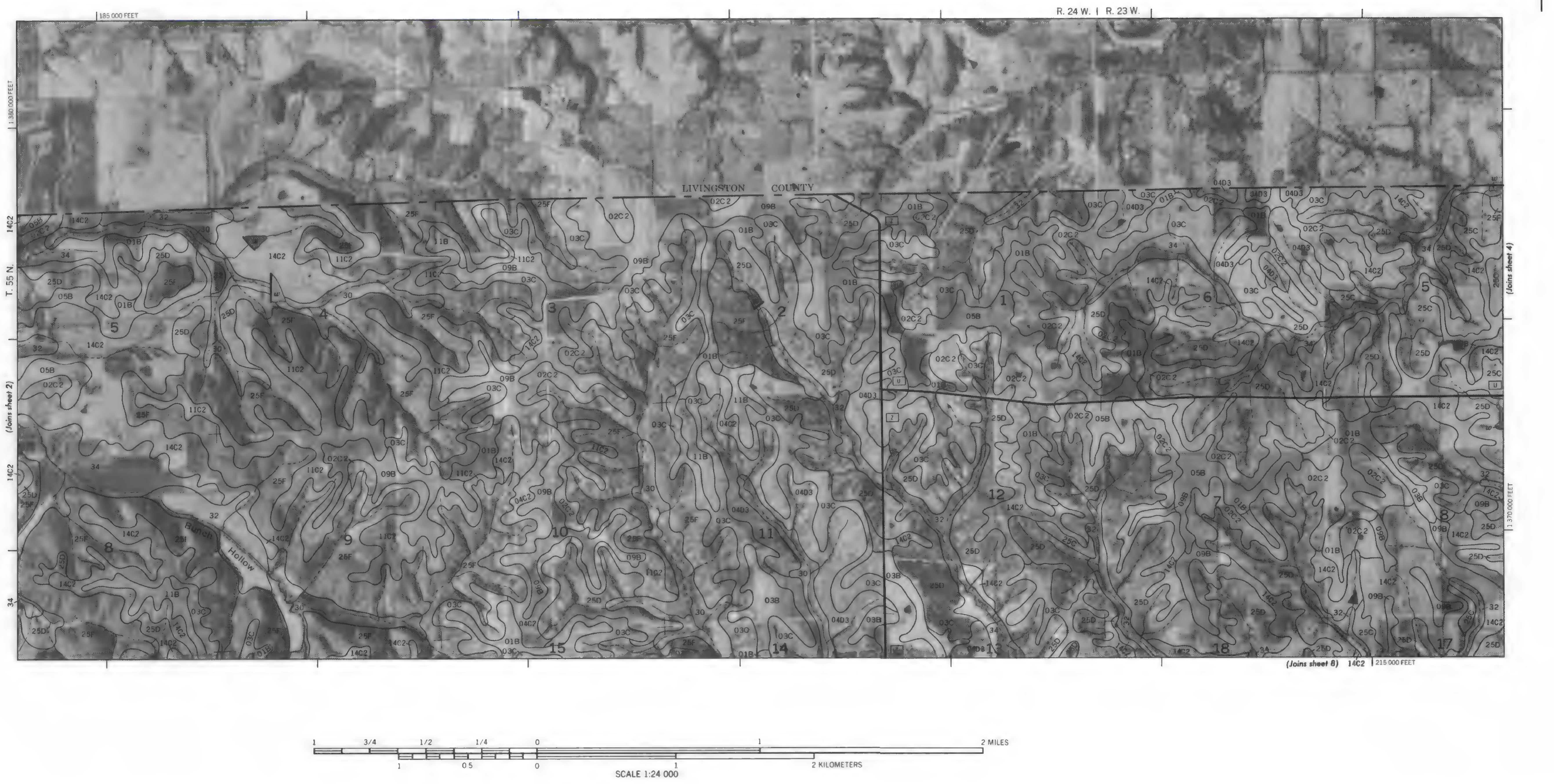
N

1 3/4 1/2 1/4 0 1 2 MILES

1 0.5 0 1 2 KILOMETERS

SCALE 1:24 000

SOIL SURVEY OF CARROLL COUNTY, MISSOURI — SHEET NUMBER 3



4
N
R. 23 W.
R. 22 W.
250 000 FEET
1 380 000 FEET
T. 55 N.
LIVINGSTON COUNTY
(Joins sheet 3)
(Joins sheet 5)
(Joins sheet 9)
220 000 FEET
Stokes Mound
Mound Creek
Bridge Cr.
Bridge Creek
MACKLIN CEMETERY
BURLINGTON NORTHERN
1 3/4 1/2 1/4 0 1 2 MILES

SOIL SURVEY OF CARROLL COUNTY, MISSOURI — SHEET NUMBER 5

N

1 3/4 1/2 1/4 0 1 2 MILES

1 0.5 0 1 2 KILOMETERS

SCALE 1:24 000

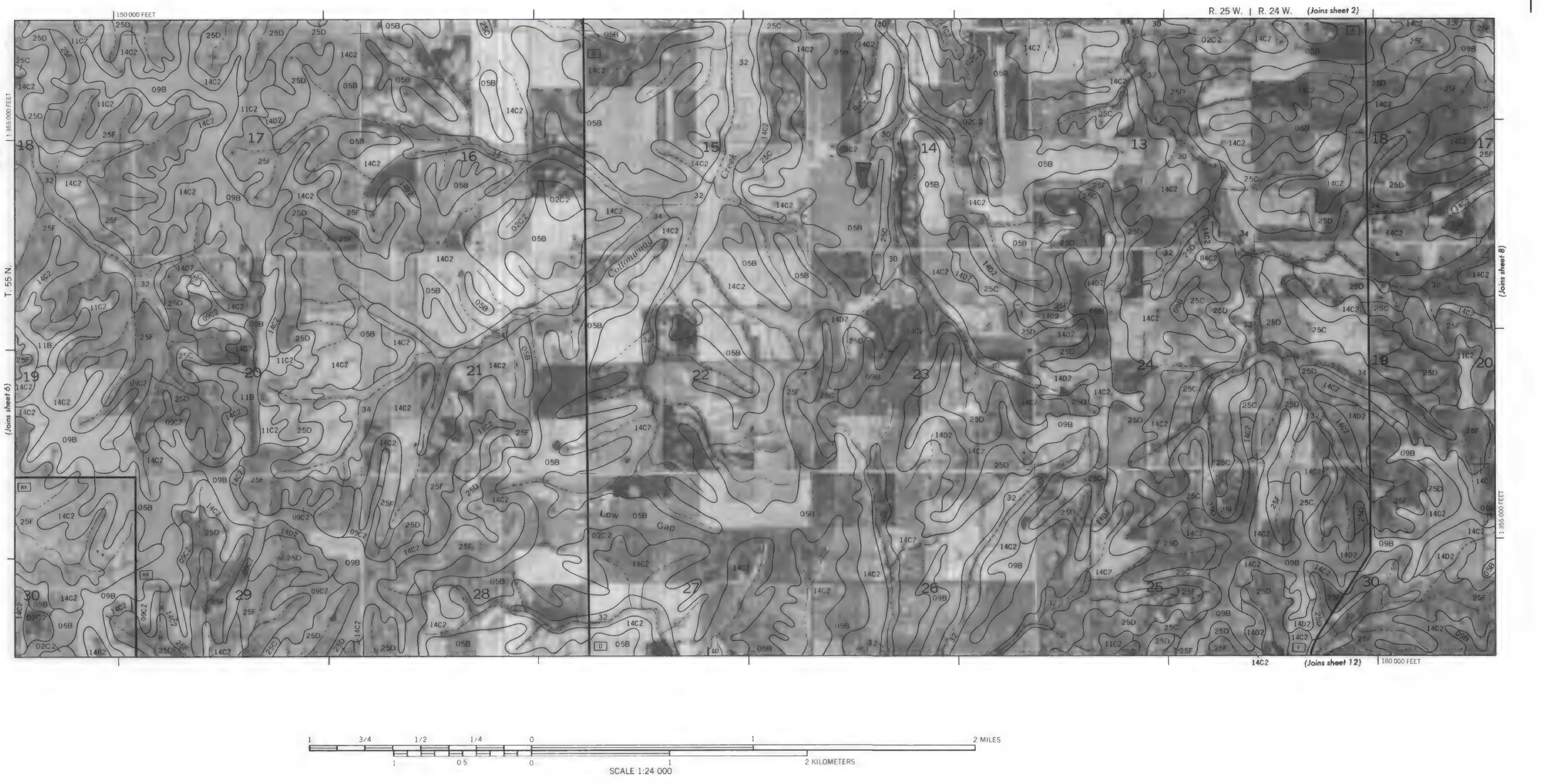
N

1 3/4 1/2 1/4 0 1 2 MILES

1 0.5 0 1 2 KILOMETERS

SCALE 1:24 000

SOIL SURVEY OF CARROLL COUNTY, MISSOURI — SHEET NUMBER 7



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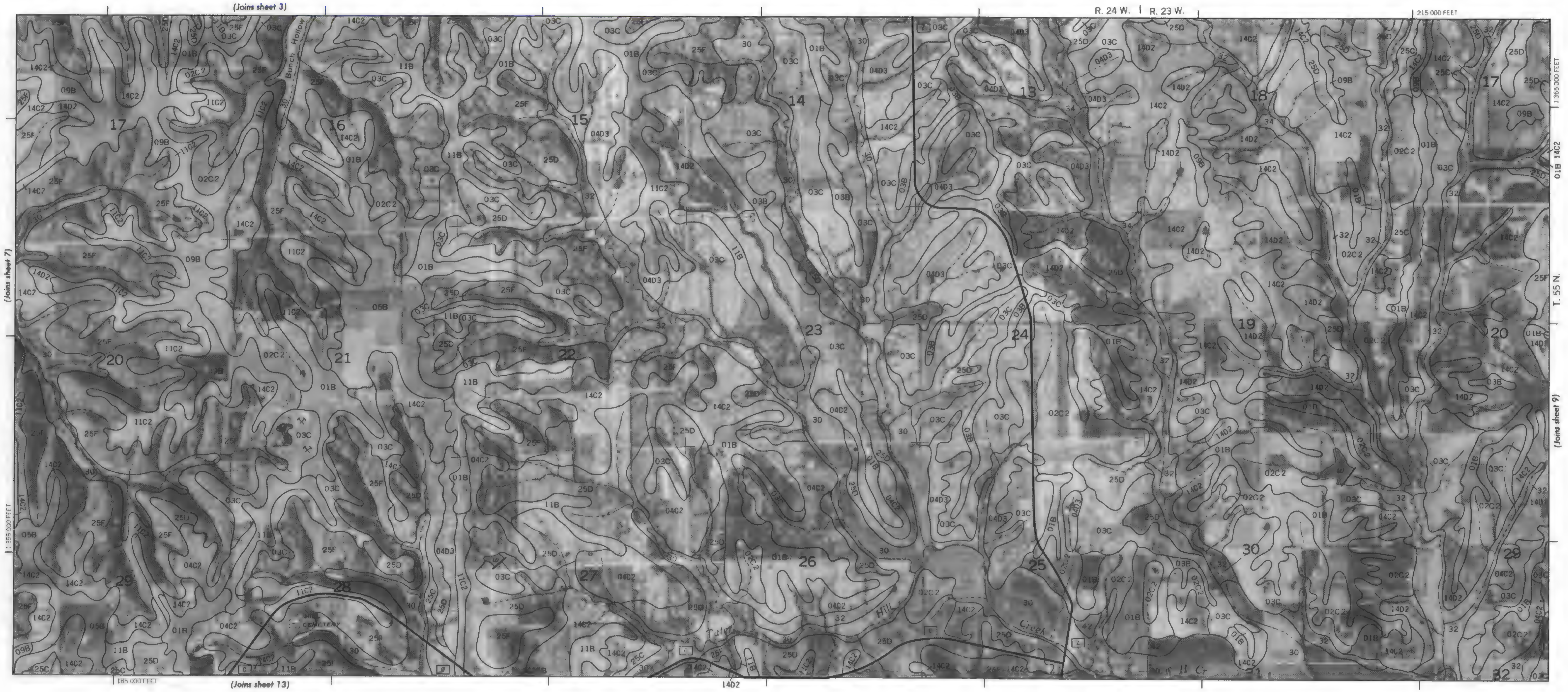
N



1 3/4 1/2 1/4 0 1 2 MILES

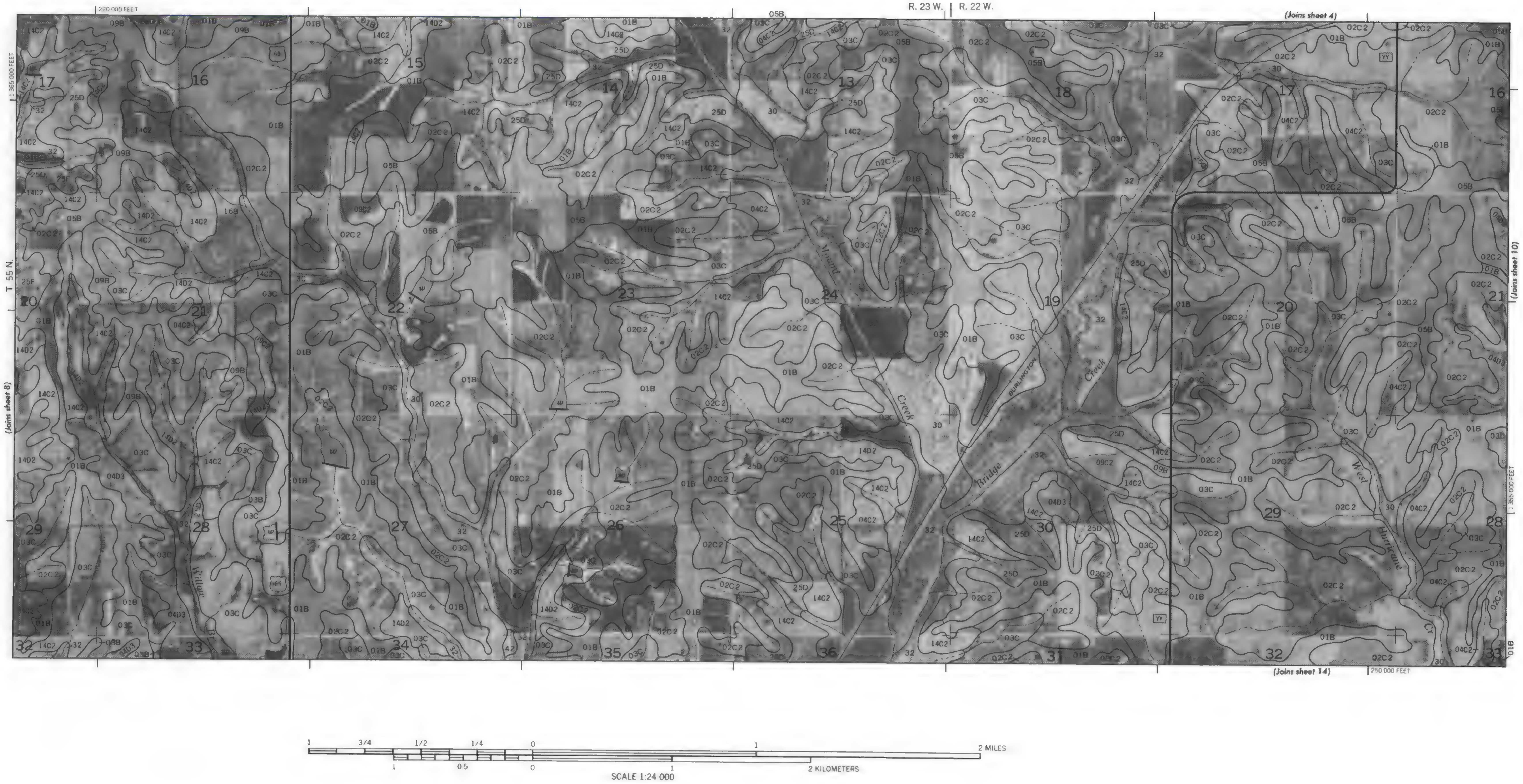
1 0.5 0 1 2 KILOMETERS

SCALE 1:24 000

SOIL SURVEY OF CARROLL COUNTY, MISSOURI — SHEET NUMBER 9

9

N



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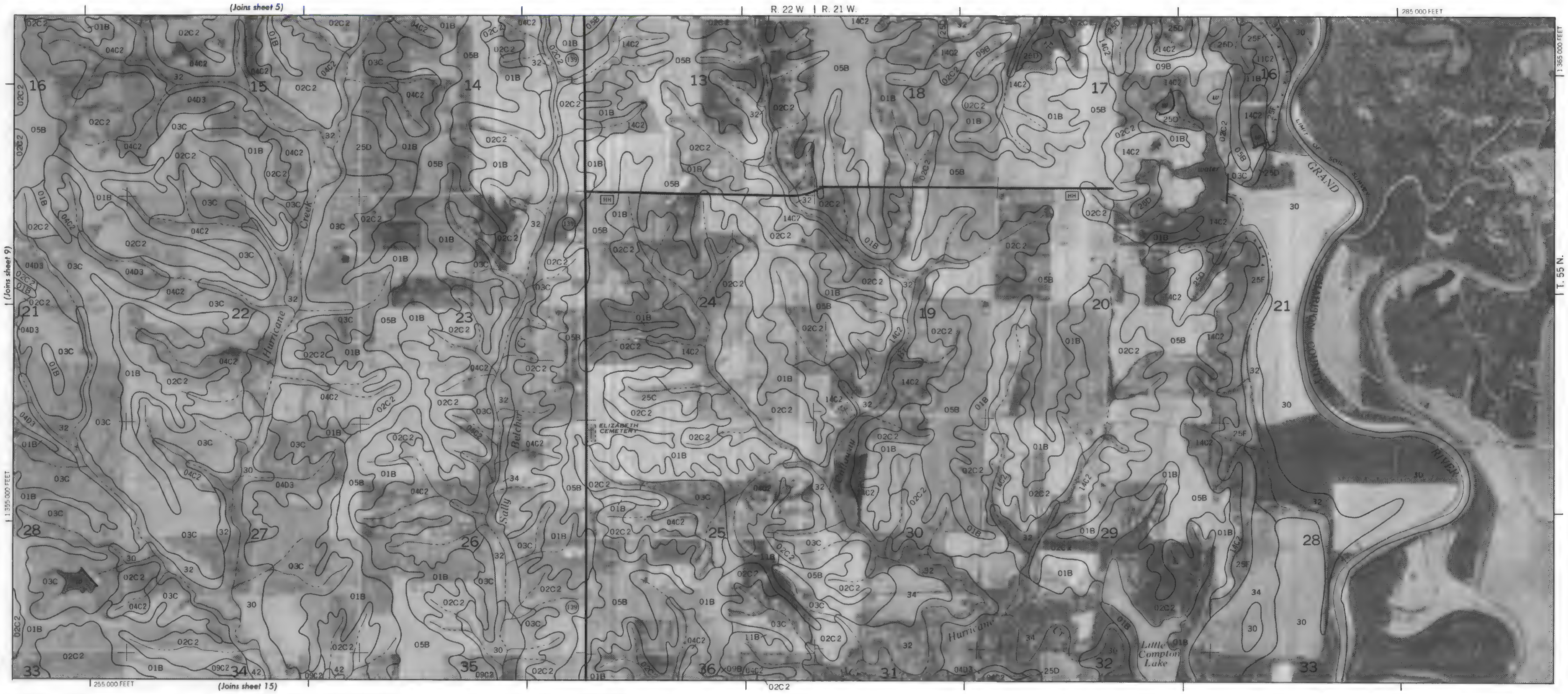


1 3/4 1/2 1/4 0 1 2 MILES

1 0.5 0 1 2 KILOMETERS

SCALE 1:24 000

11

N

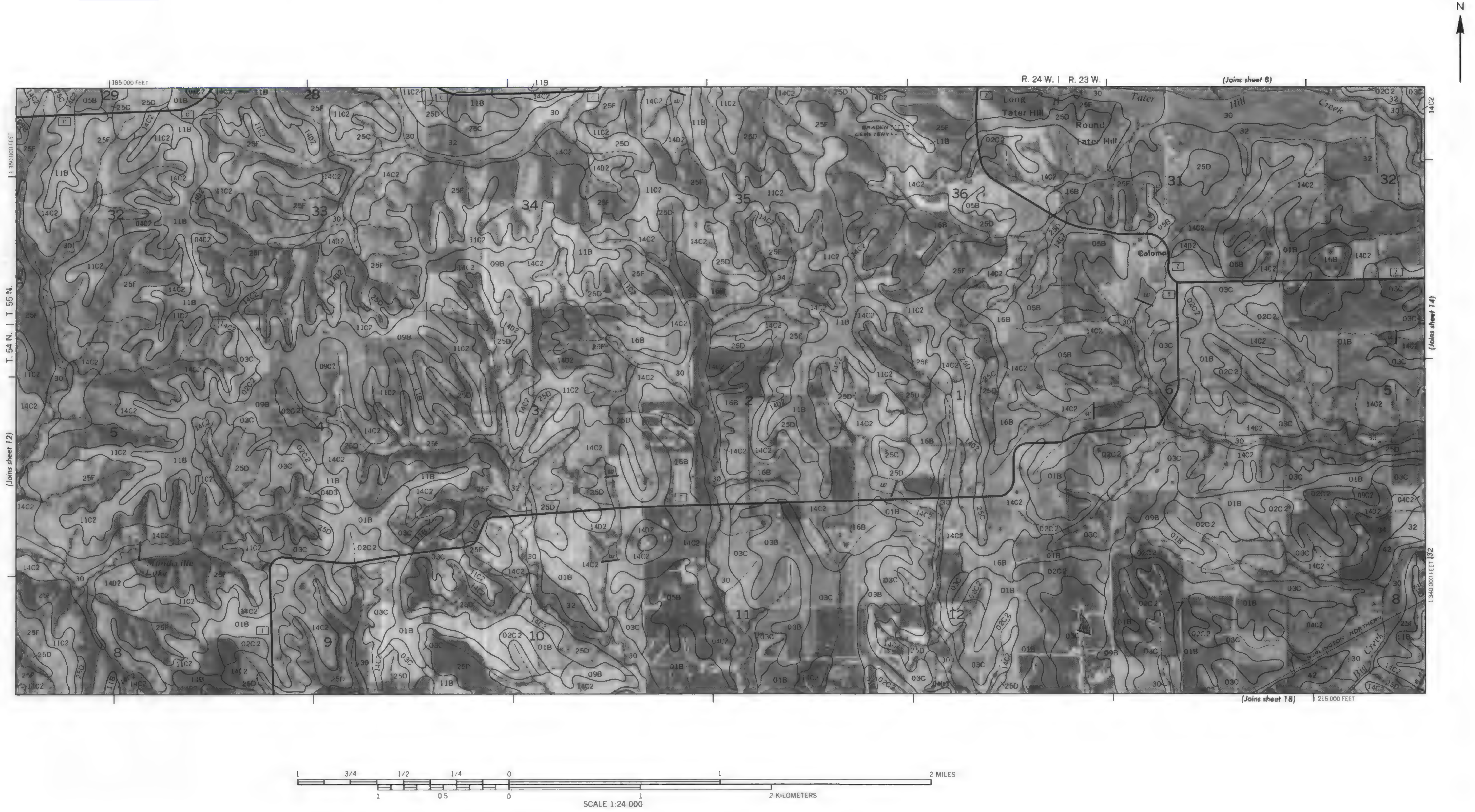
2 MILES

2 KILOMETERS

SCALE 1:24 000

SOIL SURVEY OF CARROLL COUNTY, MISSOURI — SHEET NUMBER 12

1 3/4 1/2 1/4 0 1 2 MILES
1 0.5 0 1 2 KILOMETERS
SCALE 1:24 000


13
N
R. 24 W. | R. 23 W.
(Joins sheet 8)
(Joins sheet 12)
(Joins sheet 14)
(Joins sheet 18)
T. 55 N. | T. 54 N.
185 000 FEET
1 350 000 FEET
1 340 000 FEET
215 000 FEET
Long Tater Hill
Round Tater Hill
Tater Hill Creek
Coloma
Braden Cemetery
Burlington Northern
Big Creek
SCALE 1:24 000
1 3/4 1/2 1/4 0 1 2 MILES
1 0.5 0 1 2 KILOMETERS

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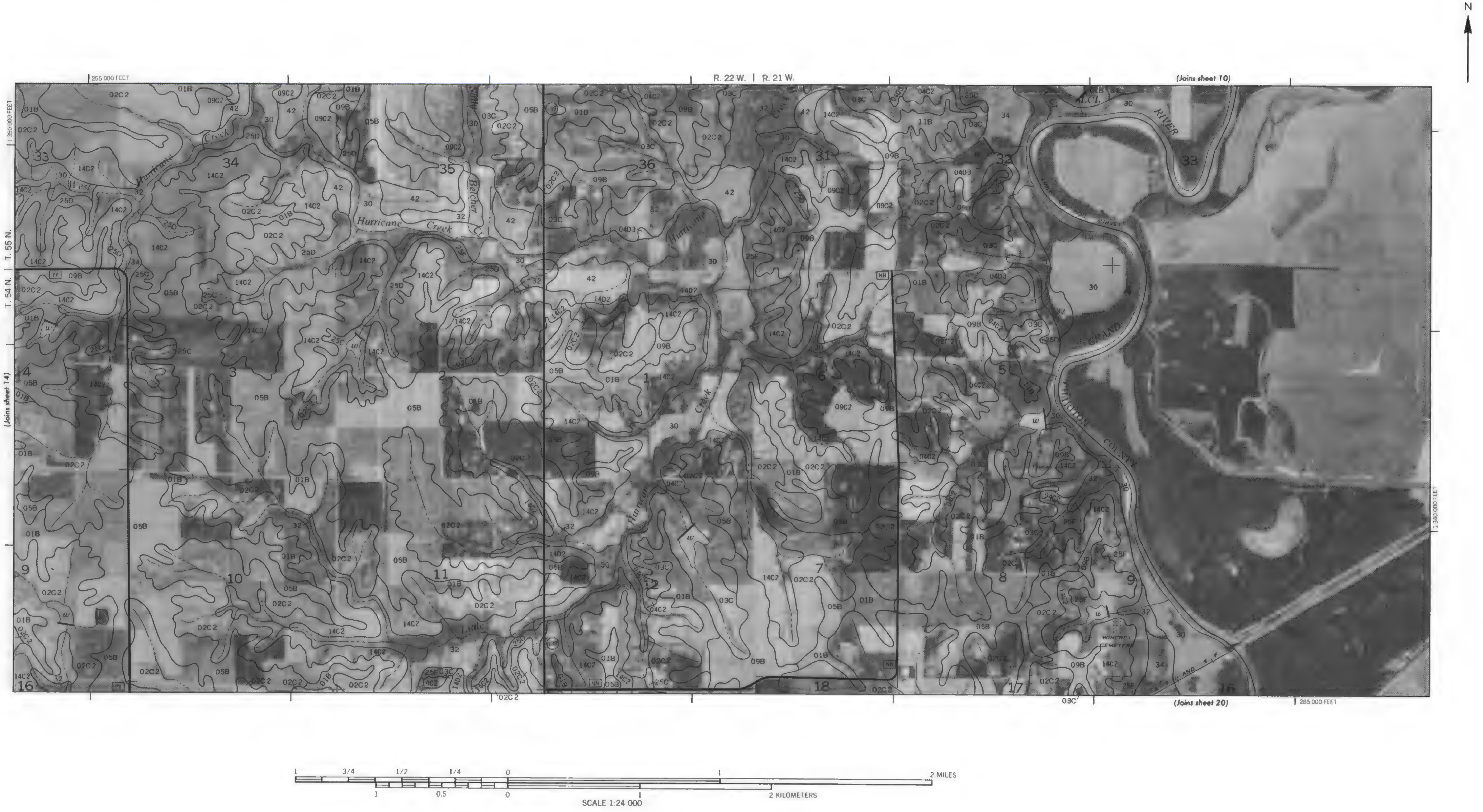
SOIL SURVEY OF CARROLL COUNTY, MISSOURI — SHEET NUMBER 15



N

1 3/4 1/2 1/4 0 1 2 MILES

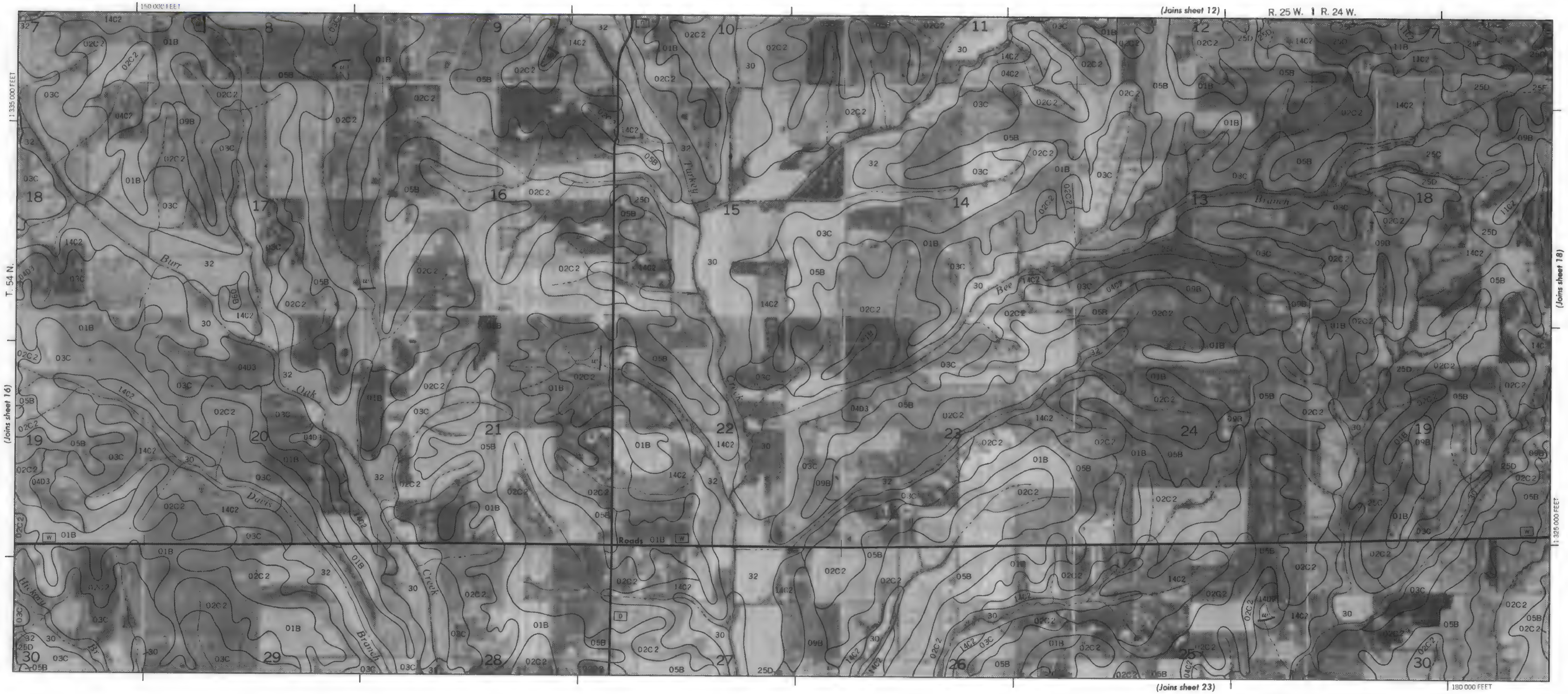
1 0.5 0 1 2 KILOMETERS

SCALE 1:24 000

SOIL SURVEY OF CARROLL COUNTY, MISSOURI — SHEET NUMBER 17

17

N



1 3/4 1/2 1/4 0 1 2 MILES

1 0.5 0 1 2 KILOMETERS

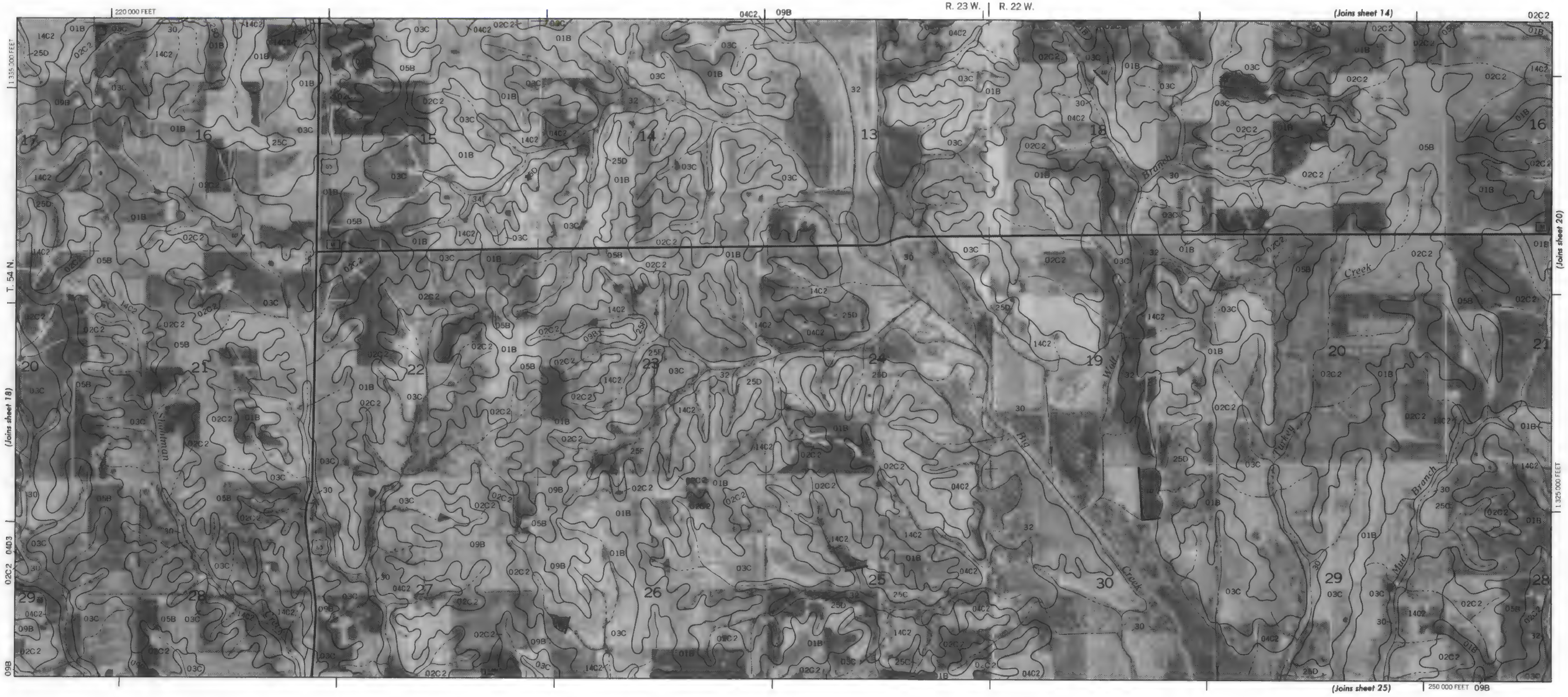
SCALE 1:24 000


18
N
(Joins sheet 13)
(Joins sheet 17)
(Joins sheet 19)
(Joins sheet 24)
R. 24 W. R. 23 W.
T. 54 N.
215 000 FEET
1 335 000 FEET
1 325 000 FEET
185 000 FEET
Mandeville
Mound Bogard
Bogard
Creek
1 3/4 1/2 1/4 0 1 2 MILES
1 0.5 0 1 2 KILOMETERS
SCALE 1:24 000

SOIL SURVEY OF CARROLL COUNTY, MISSOURI — SHEET NUMBER 19

19

N

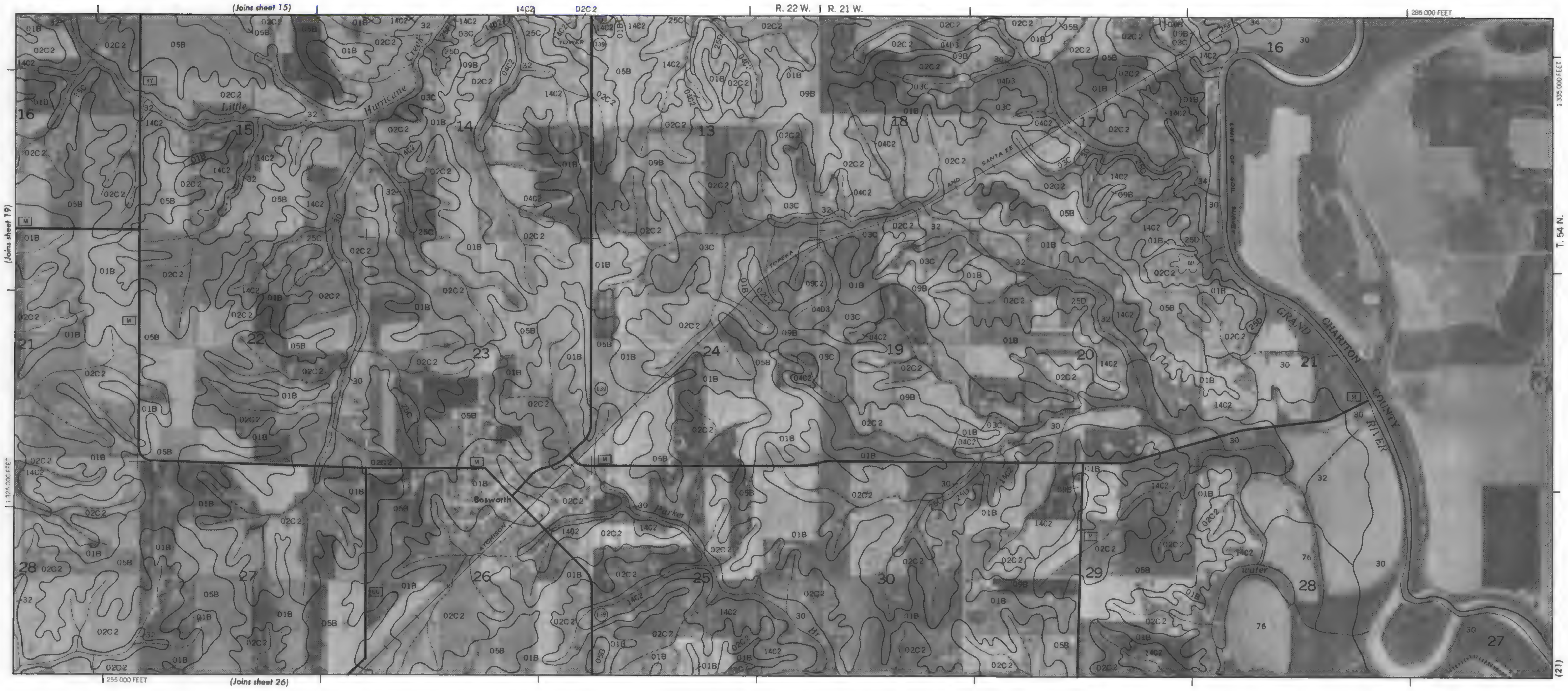


1 3/4 1/2 1/4 0 1 2 MILES

1 0.5 0 1 2 KILOMETERS

SCALE 1:24 000

N



1 3/4 1/2 1/4 0 1 2 MILES

1 0.5 0 1 2 KILOMETERS

SCALE 1:24 000


21
N
290 000 FEET
R. 21 W.
1 335 000 FEET
T. 54 N.
(Joins sheet 20)
CHARITON COUNTY
GRAND RIVER
LIMIT OF SOIL SURVEY
23
30
76
26
30
34
30
76
76
27
30
1 325 000 FEET
(Joins sheet 27)
320 000 FEET
1
3/4
1/2
1/4
0
1
2 MILES
1
0.5
0
1
2 KILOMETERS
SCALE 1:24 000

SOIL SURVEY OF CARROLL COUNTY, MISSOURI — SHEET NUMBER 22

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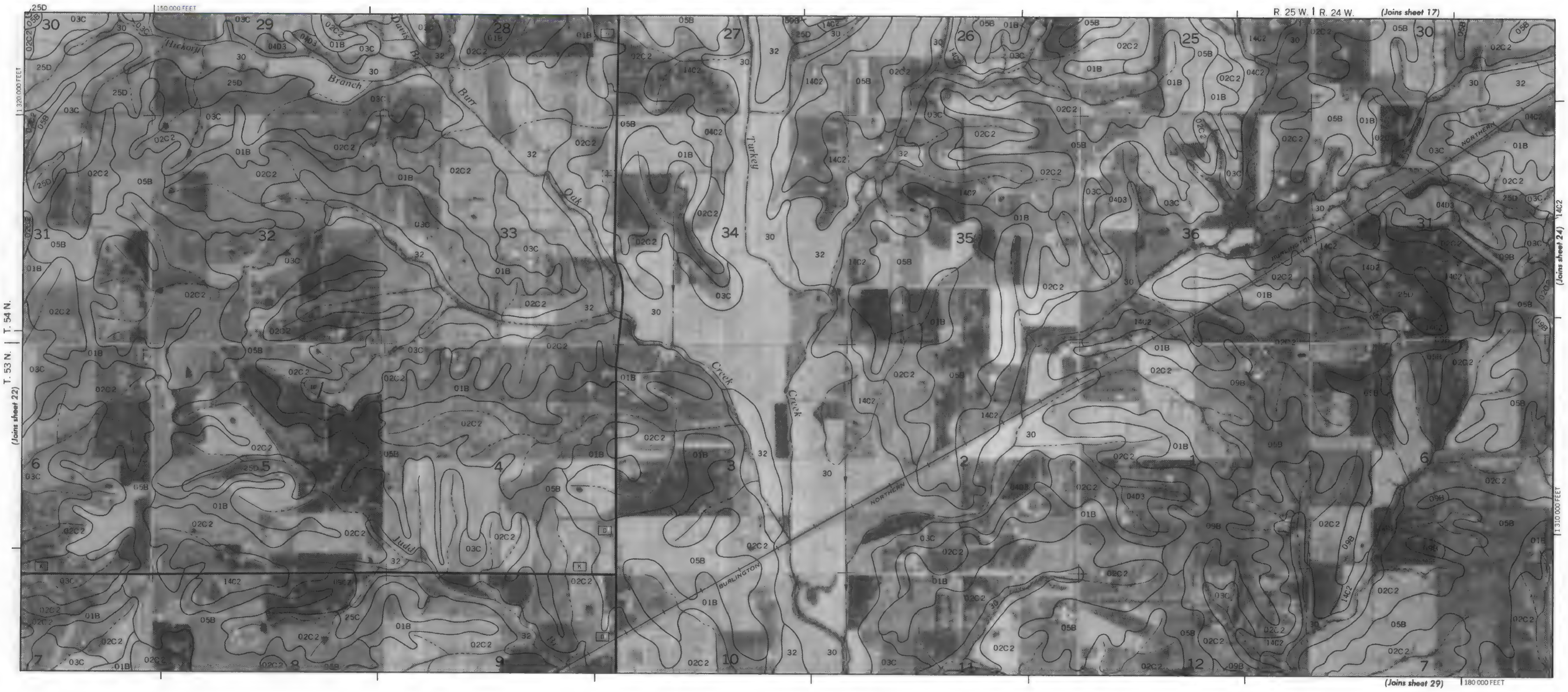
23

N



1 3/4 1/2 1/4 0 1 2 MILES

1 0.5 0 1 2 KILOMETERS

SCALE 1:24 000

N

1 3/4 1/2 1/4 0 1 2 MILES

1 0.5 0 1 2 KILOMETERS

SCALE 1:24 000

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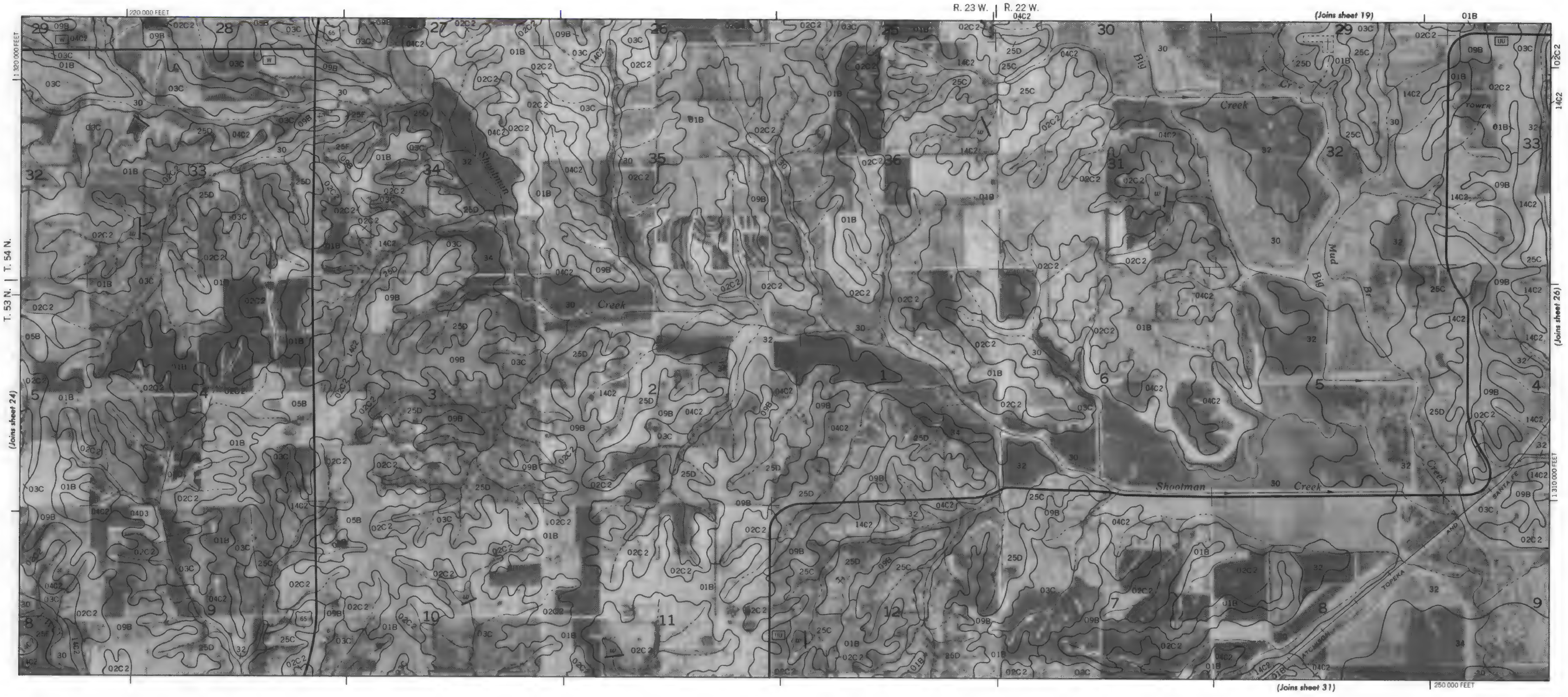
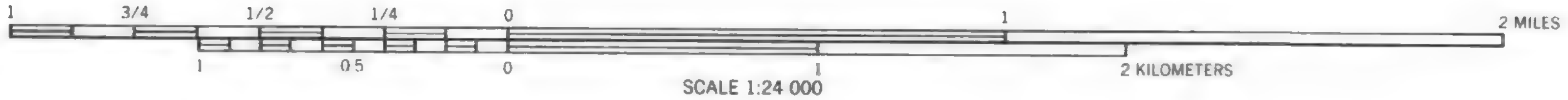
SOIL SURVEY OF CARROLL COUNTY, MISSOURI — SHEET NUMBER 25

25

N





SCALE 1:24 000

SOIL SURVEY OF CARROLL COUNTY, MISSOURI — SHEET NUMBER 26

N

1 3/4 1/2 1/4 0 1 2 MILES

1 0.5 0 1 2 KILOMETERS

SCALE 1:24 000

N

1 3/4 1/2 1/4 0 1 2 MILES

1 0.5 0 1 2 KILOMETERS

SCALE 1:24 000

N

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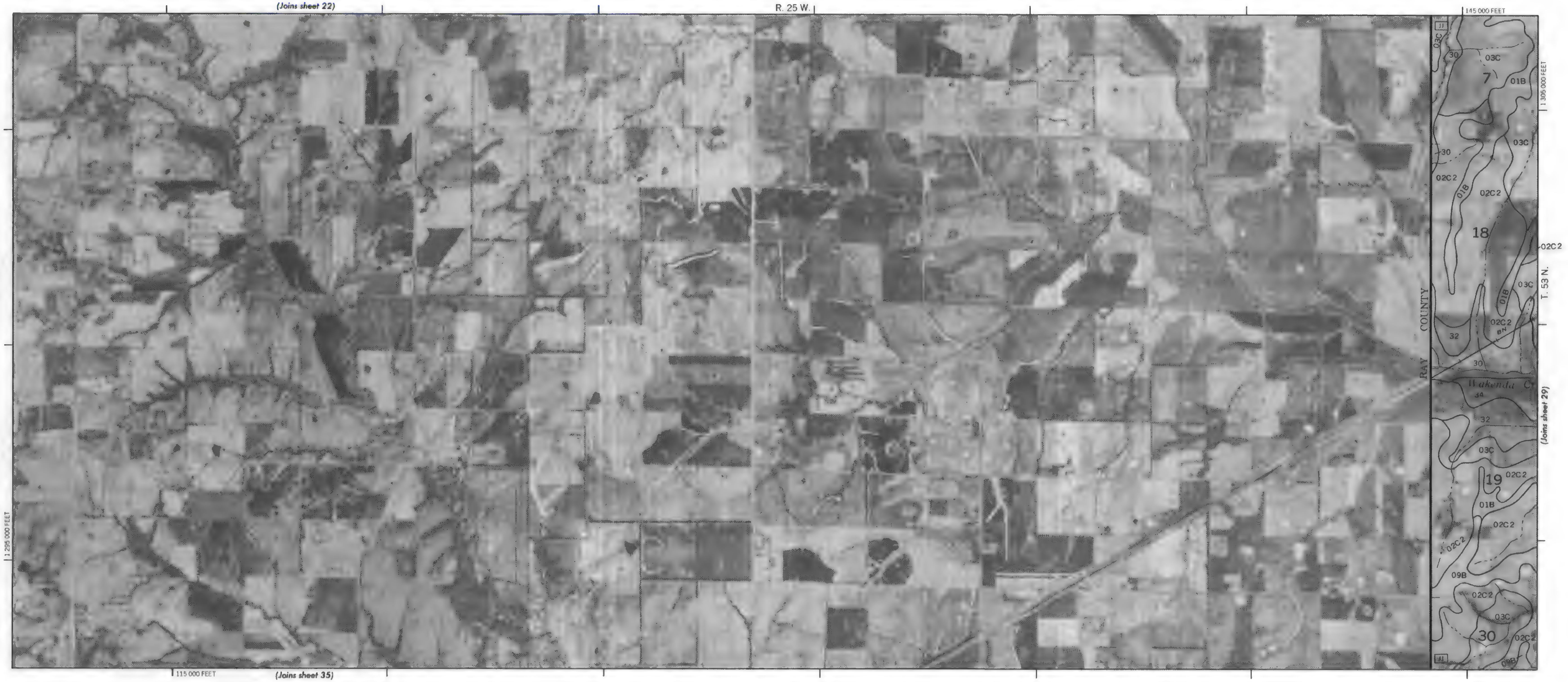


1 3/4 1/2 1/4 0 1 2 MILES

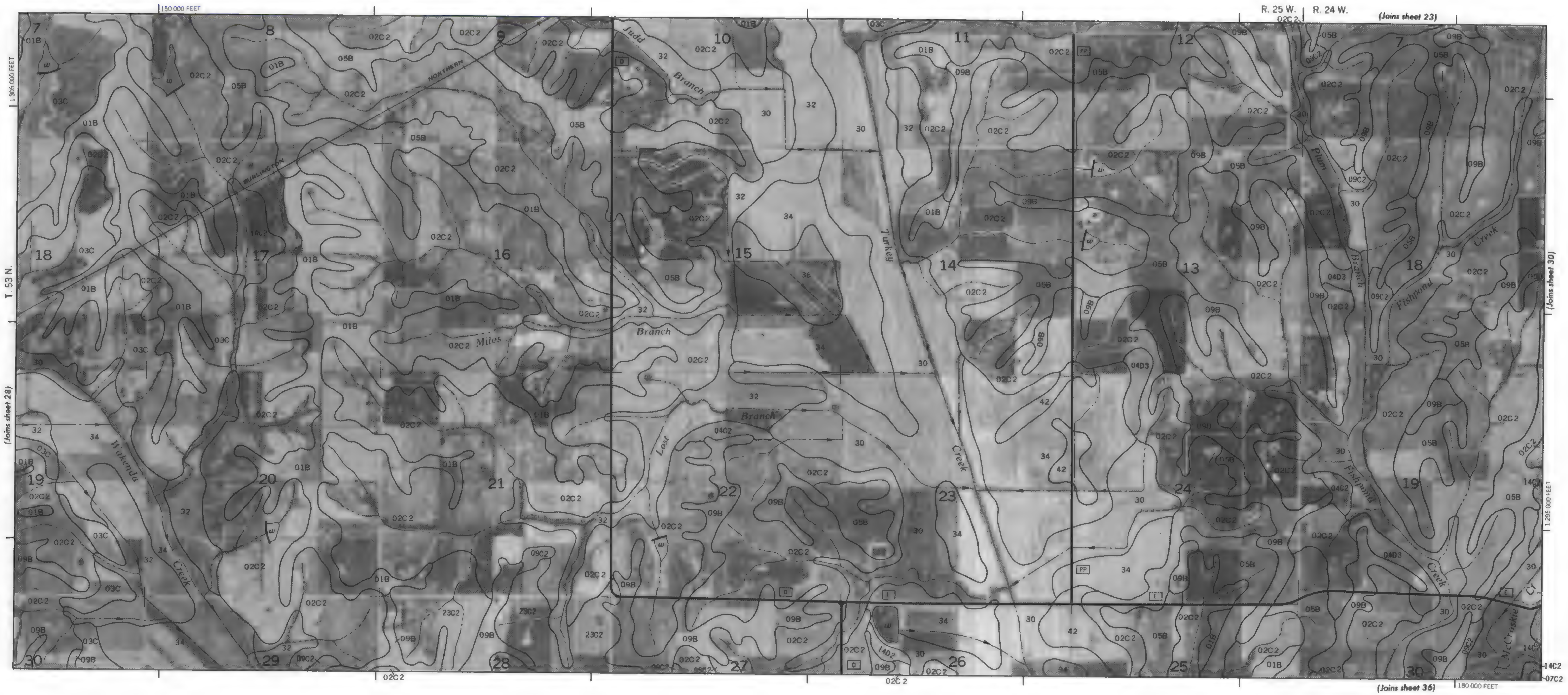
1 0.5 0 1 2 KILOMETERS

SCALE 1:24 000

SOIL SURVEY OF CARROLL COUNTY, MISSOURI — SHEET NUMBER 29

29

N



1 3/4 1/2 1/4 0 1 2 MILES

1 0.5 0 1 2 KILOMETERS

SCALE 1:24 000

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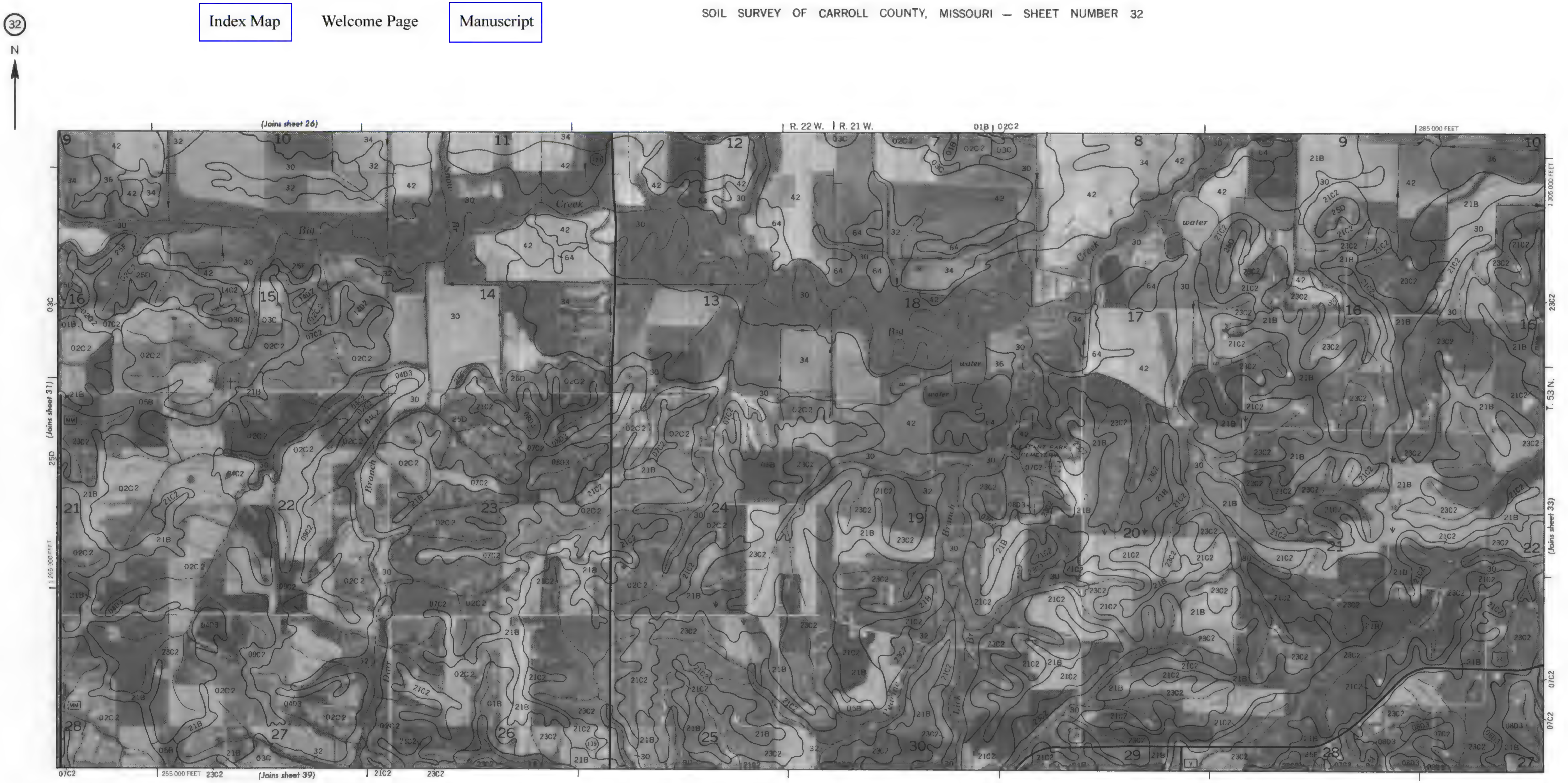
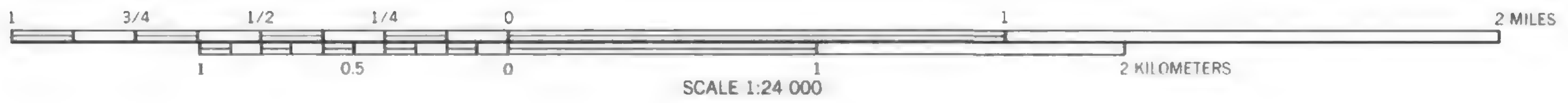
SOIL SURVEY OF CARROLL COUNTY, MISSOURI — SHEET NUMBER 31

SOIL SURVEY OF CARROLL COUNTY, MISSOURI — SHEET NUMBER 32





SOIL SURVEY OF CARROLL COUNTY, MISSOURI — SHEET NUMBER 33

1 3/4 1/2 1/4 0 1 2 MILES

1 0.5 0 1 2 KILOMETERS

SCALE 1:24 000

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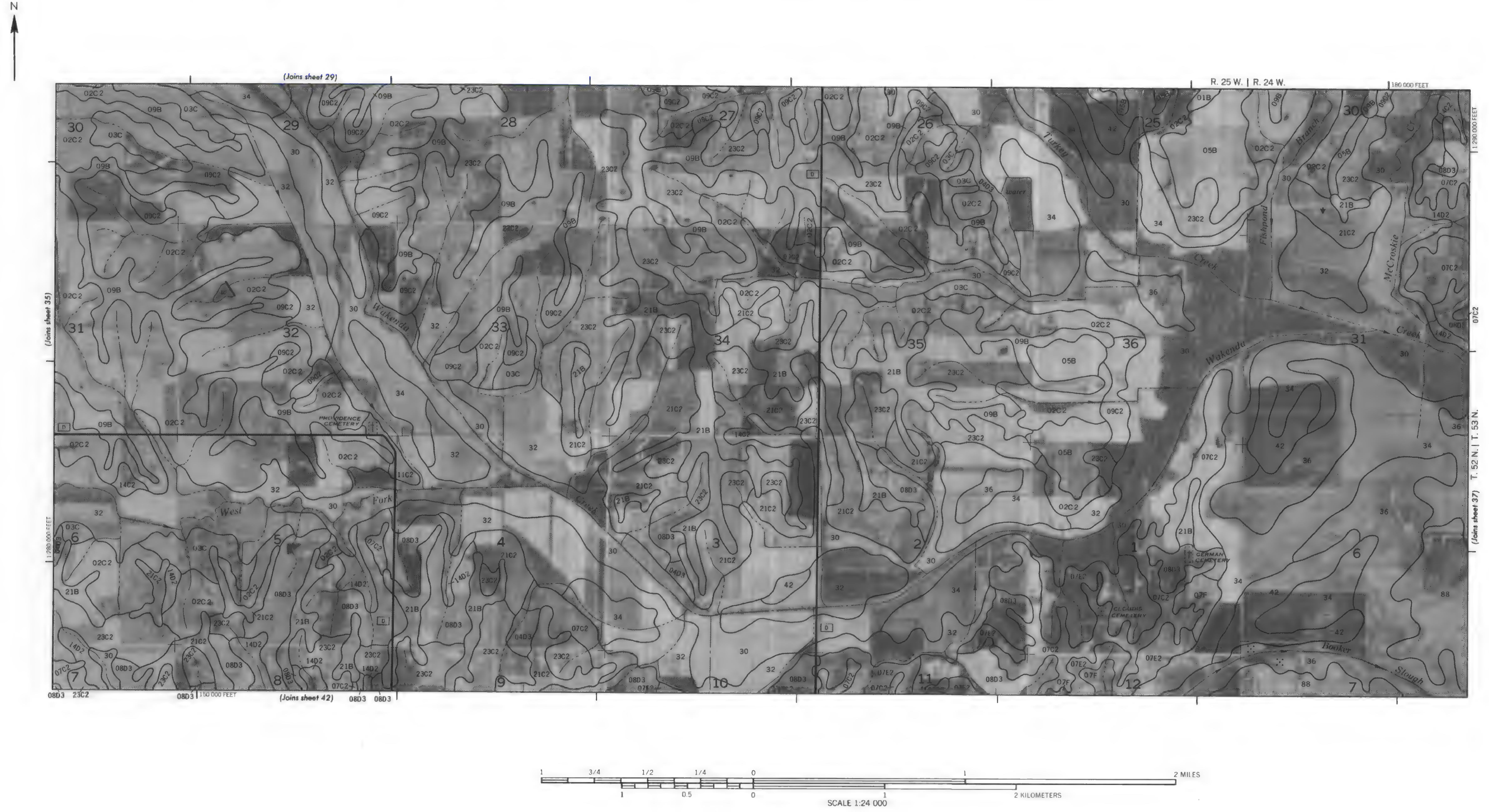
35
N
R. 25 W.
(Joins sheet 28)
(Joins sheet 36)
(Joins sheet 41)
T. 52 N. | T. 53 N.
RAY COUNTY
Wakenda Cr
30
31
32
6
7
02C2
03C
09B
09C2
04D3
07C2
08D3
21B
23C2
25D
SCALE 1:24 000
2 MILES
2 KILOMETERS


N
(Joins sheet 29)
(Joins sheet 35)
(Joins sheet 37)
(Joins sheet 42)
R. 25 W. | R. 24 W.
T. 52 N. | T. 53 N.
180 000 FEET
1 280 000 FEET
150 000 FEET
Wakenda Creek
West Fork
Turkey Creek
Fishpond Branch
McCroskie Creek
Booker Slough
PROVIDENCE CEMETERY
GERMAN CEMETERY
CLOUDIS CEMETERY
1 3/4 1/2 1/4 0 1 2 MILES
1 0.5 0 1 2 KILOMETERS
SCALE 1:24 000

SOIL SURVEY OF CARROLL COUNTY, MISSOURI — SHEET NUMBER 37

37

N

1 3/4 1/2 1/4 0 1 2 MILES

1 0.5 0 1 2 KILOMETERS

SCALE 1:24 000

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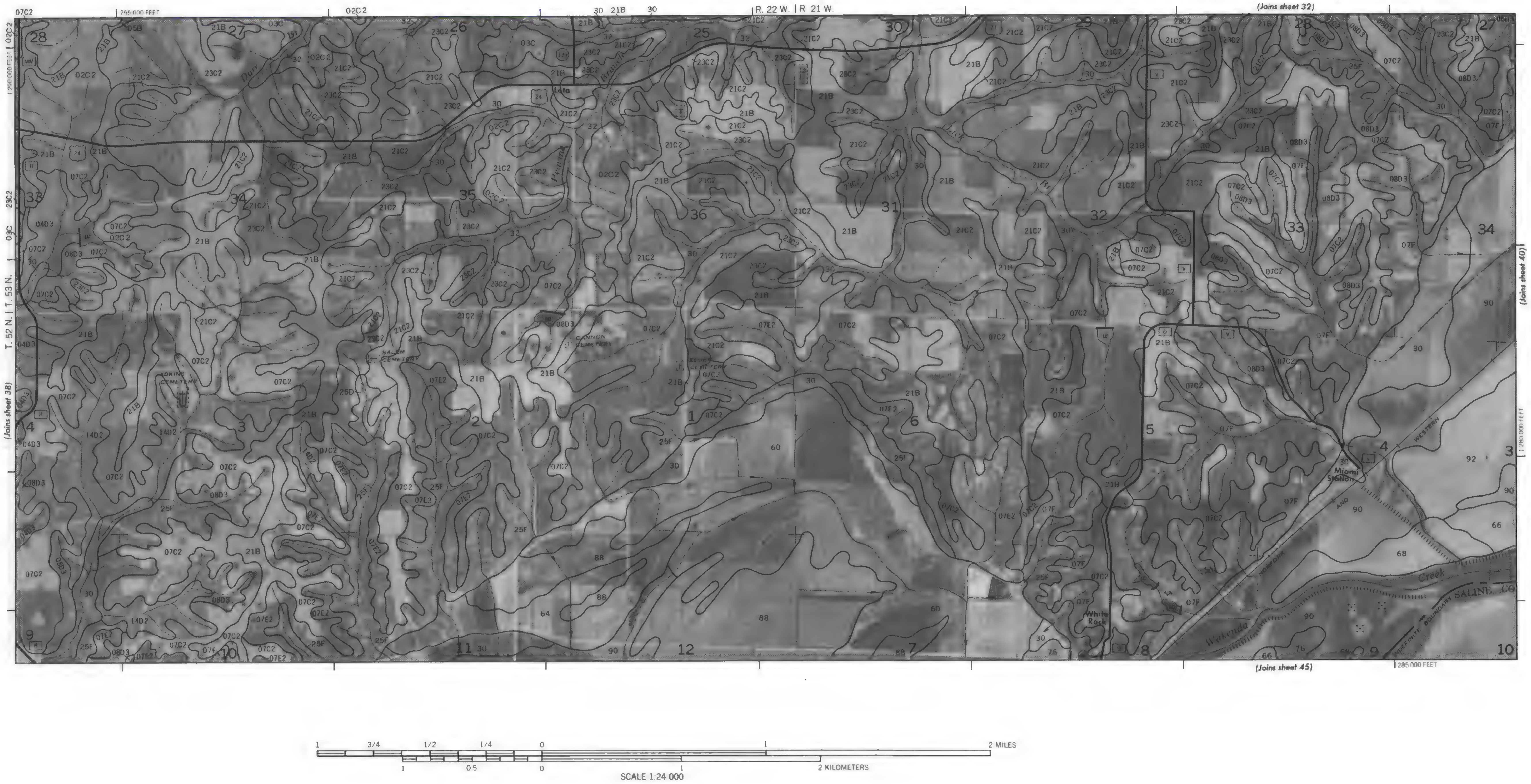
SCALE 1:24 000

1 3/4 1/2 1/4 0 1 2 MILES

1 0.5 0 1 2 KILOMETERS


N
(Joins sheet 32)
(Joins sheet 38)
(Joins sheet 40)
(Joins sheet 45)
R. 22 W. | R. 21 W.
T. 52 N. | T. 53 N.
255 000 FEET
1 290 000 FEET
1 280 000 FEET
285 000 FEET
Miami Station
White Rock
SALINE CO
1 3/4 1/2 1/4 0 1 2 MILES
1 0.5 0 1 2 KILOMETERS
SCALE 1:24 000

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1 3/4 1/2 1/4 0 1 2 MILES
1 0.5 0 1 2 KILOMETERS
SCALE 1:24 000


42
N
(Joins sheet 36)
(Joins sheet 41)
(Joins sheet 43)
(Joins sheet 48)
R. 25 W.
R. 24 W.
T. 52 N.
180 000 FEET
1 275 000 FEET
1 265 000 FEET
150 000 FEET
LUTHERAN CEMETERY
Slough
water
SPOIL BANK
NORBORNE DRAINAGE DITCH
ATCHISON TOPEKA AND SANTA FE
NORFOLK AND WESTERN
FAIRHAVEN CEMETERY
Norborne
1 3/4 1/2 1/4 0 1 2 MILES
1 0.5 0 1 2 KILOMETERS
SCALE 1:24 000

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SOIL SURVEY OF CARROLL COUNTY, MISSOURI — SHEET NUMBER 44

44

N

1 3/4 1/2 1/4 0 1 2 MILES

1 0.5 0 1 2 KILOMETERS

SCALE 1:24 000

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46

N

1 3/4 1/2 1/4 0 1 2 MILES

1 0.5 0 1 2 KILOMETERS

SCALE 1:24 000

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47

N

SCALE 1:24 000

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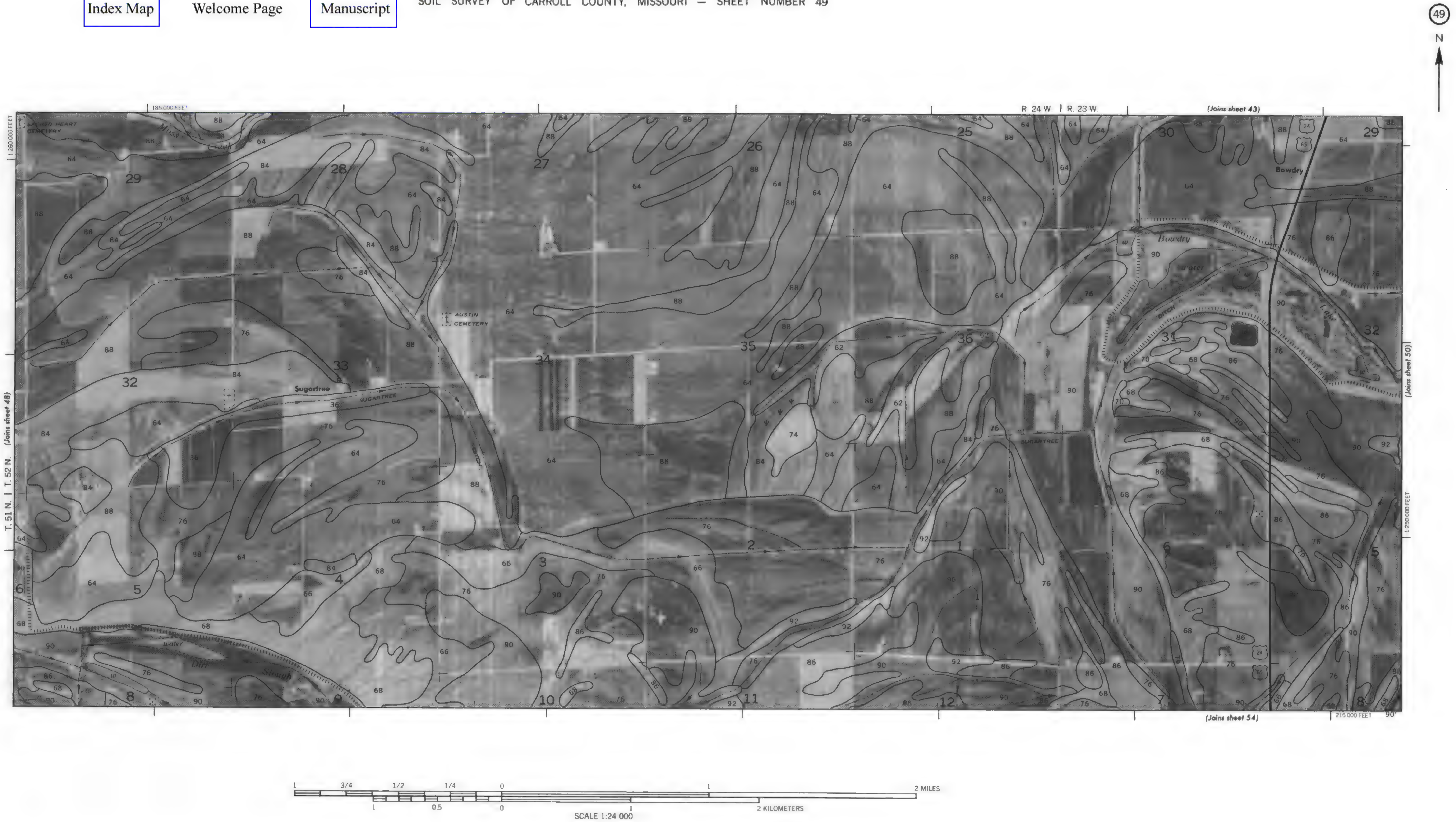
49
N
R. 24 W. | R. 23 W.
(Joins sheet 43)
(Joins sheet 48)
T. 51 N. | T. 52 N.
(Joins sheet 50)
(Joins sheet 54)
SACRED HEART CEMETERY
AUSTIN CEMETERY
Sugartree
SUGARTREE
Bowdry
Lake
water
Dry Slough
1 3/4 1/2 1/4 0 1 2 MILES
1 0.5 0 1 2 KILOMETERS
SCALE 1:24 000

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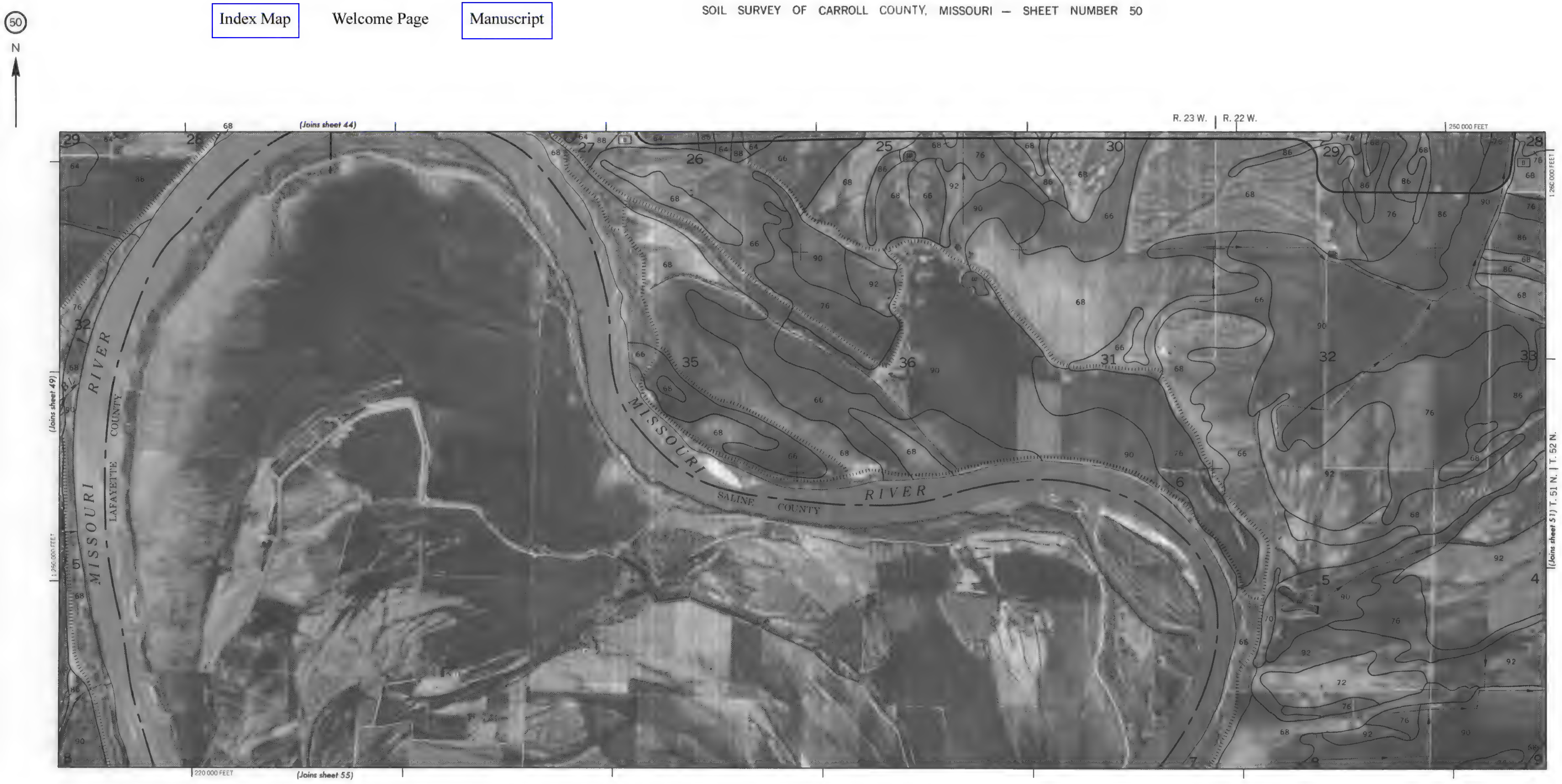

1 3/4 1/2 1/4 0 1 2 MILES

1 0.5 0 1 2 KILOMETERS

SCALE 1:24 000

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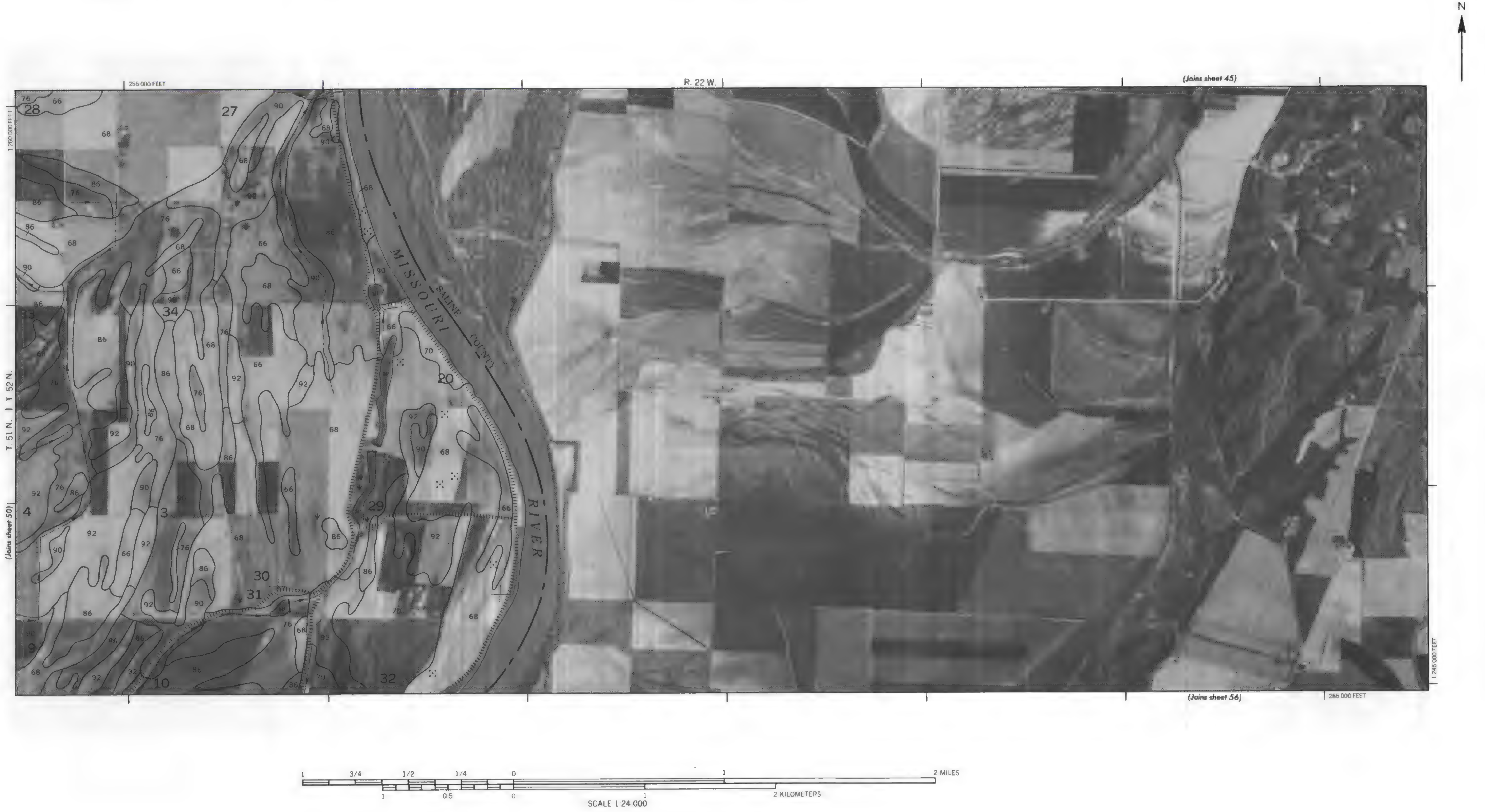


N
(Joins sheet 47)
R. 25 W.
145 000 FEET
1 245 000 FEET
T. 51 N.
(Joins sheet 53)
RAY COUNTY
76
74
62
84
7
64
76
74
84
76
84
18
88
84
76
74
76
90
68
90
68
19
92
86
68
MISSOURI RIVER
LAFAYETTE CO
1 230 000 FEET
115 000 FEET
1
3/4
1/2
1/4
0
1
2 MILES
1
0.5
0
1
2 KILOMETERS
SCALE 1:24 000

SOIL SURVEY OF CARROLL COUNTY, MISSOURI — SHEET NUMBER 53

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SOIL SURVEY OF CARROLL COUNTY, MISSOURI — SHEET NUMBER 55

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